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July 16, 1927

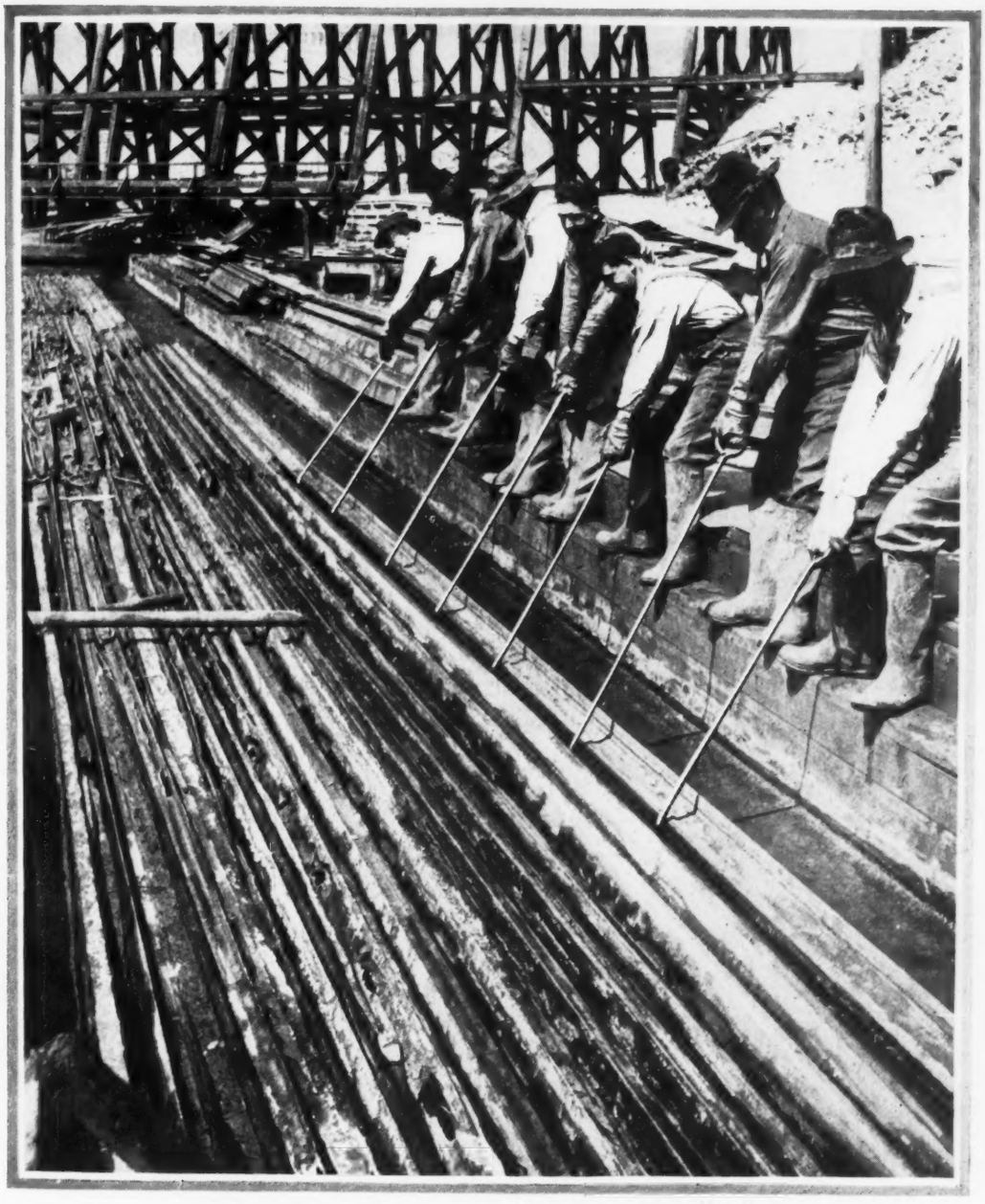
McGRAW-HILL PUBLISHING COMPANY, INC.

TWENTY-FIVE CENTS PER COPY

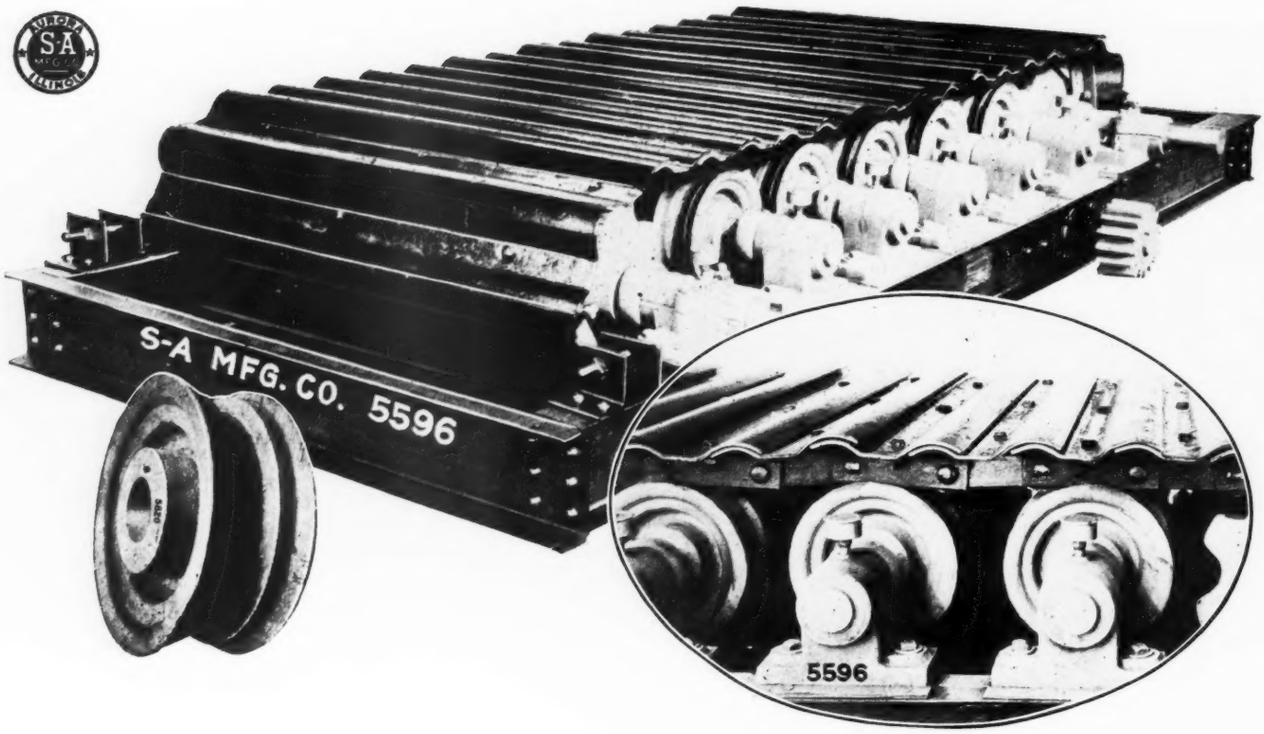
ENGINEERING AND MINING JOURNAL

A Consolidation of Engineering and Mining Journal and Mining and Scientific Press

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING



Costs of Constructing and Equipping Inspiration's Copper-Leaching Plant, by George H. Booth — Rejuvenating a Bolivian Placer, by Dwight E. Woodbridge — Mining Sodium Sulphate at Camp Verde, Arizona, by George J. Young — With the Geologists in Spain, by T. A. Rickard



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The large diameter rollers are mounted on cross shafts which turn in large, easily lubricated bearings.

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This type of feeder is just one of the many S-A Feeders for heavy duty. They are built in sizes and widths to suit requirements.

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Write for Bulletin No. 143 Describing S-A Roller Track Feeders

Stephens-Adamson Mfg. Co.

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Volume 124 New York, July 16, 1927 *Number* 3

ENGINEERING AND
MINING JOURNAL

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McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

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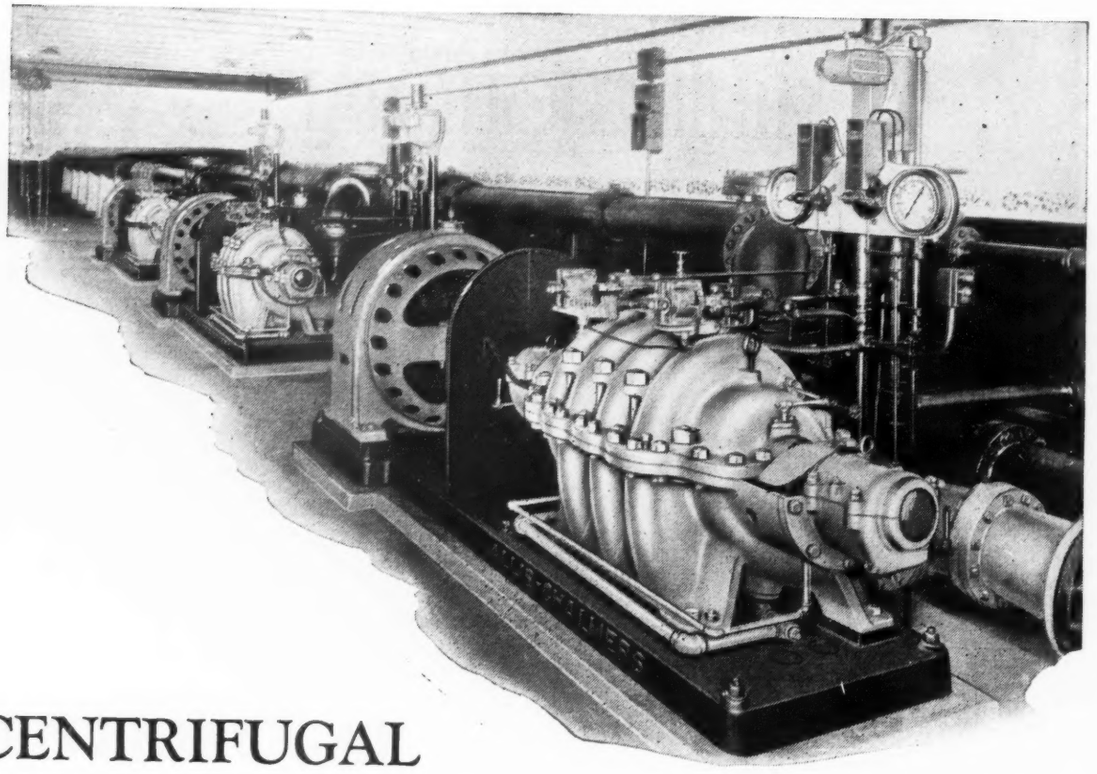
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."
Copyright 1927
By McGraw-Hill Publishing Company, Inc.
Publishers of
Engineering News-Record **American Machinist**
Power **Chemical and Metallurgical Engineering**
Coal Age **Engineering and Mining Journal**
Ingenieria Internacional
Electrical World **Electrical Merchandising**
Bus Transportation **Electric Railway Journal**
Industrial Engineer **Radio Retailing**
Construction Methods
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

The annual subscription rate in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Chili, Haiti and Paraguay, $5 per year. Extra foreign postage, $3 (total $8 or 34 shillings). Single copy, 25c. Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at New York at least ten days before the change takes place. Published weekly. Entered as second-class matter June 20, 1879, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.
Member Audit Bureau of Circulations.
Member Associated Business Papers, Inc.

11,767 COPIES PRINTED THIS ISSUE



CENTRIFUGAL MINE PUMPS

Built for endurance

The illustration shows three of the four 10 in. x 8 in. four stage bronze mine pumps installed by the Lehigh Valley Coal Co. in 1923. No repairs have been ordered since this installation was placed in service. Another example of still more enduring service is the 16 in. six stage bronze mine pump furnished the D. L. & W. Ry. Co. in 1909 which is still in service with the original Casings. Allis-Chalmers mine pumps may cost a little more at first but there is extra metal where needed and other special features which make for enduring service.

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

ENGINEERING AND
MINING JOURNAL

Volume 124 New York, July 16, 1927 *Number* 3

Economics vs. Politics

TWO CONFERENCES called for the purpose of analyzing the economic condition of the world and devising ways for promoting international trade have now come to an end—one at Geneva and the other at Stockholm. As the discussion was largely carried on by economists, and the aim of the conferences was to promote the welfare of all countries rather than special interests in individual countries, the principal conclusion reached was, naturally, that trade barriers in the various nations should be lowered so that international commerce would be facilitated. Resolutions were passed and machinery was put in motion having this end in view. Now, the delegates will return to their respective countries, each of which has a protective tariff schedule that sets up a more or less formidable barrier. They will find that the tariff is a political issue rather than an economic one, and that as the various nations of the world are governed by politicians who have the selfish interests of their home constituencies at heart rather than the good of the nation as a whole, or certainly the world as a whole, any attempt at tariff reduction will involve political considerations.

If the world were to start afresh, with every country developed to somewhat the same extent and with economic conditions in the various nations presenting no violent contrasts; and, further, if international wars were done away with, international free trade would no doubt be desirable, for the economic arguments in its favor are fundamentally sound. Such conditions do not now prevail, and the best one can do is to work, as the representatives at these two conferences have suggested, for a gradual lowering of the trade barriers, chief of which is the tariff. Public opinion must be educated; producers of raw products and manufacturers must be shown that by giving up immediate, individual, and definite advantages, they and their fellows will be benefited in the long run.

Many countries have two major political parties, one of which advocates a high protective tariff, and the other anything from a medium protective tariff down to free trade. Any sudden downward change in tariff schedules, following a change in the political party in power, is almost sure to work havoc with industries suddenly deprived of their accustomed protection, and thus interfere with the economic condition of the nation as a whole. Better a high tariff all the time than one that is first down and then up. If the tariff could be lowered gradually, and the trend known for some years in advance, producers could take steps to divorce themselves of such activities as could not be economically carried on in their own district, and turn their energies to the production of those things for which their natural situation and acquired ability fitted them.

Advocates of a continued high tariff will immediately raise the question of the relative standards of living between various countries; they will argue that the United States, with labor at $4 or more a day, cannot be expected to compete with some lowly European or Asiatic country where the laborer lives in squalor and gets but $1 a day. One answer is that we do compete in many lines as it is. Probably there are more American automobiles in China than Chinese machines, even though the laborer there gets only a few cents a day. Another answer is that, with more international trade, the wages and living conditions in other countries will more nearly approach the higher level.

Another argument is that each nation should be self-sufficient unto itself in case of war. Several opposing ideas may be offered to this: one can lay in stocks of essential war necessities, develop substitutes, or, as we become more civilized, take steps to make war impossible.

A third argument often advanced is that the income from a tariff is needed to help pay the cost of government. This has come to be a very poor argument indeed. Not long ago—in the years immediately preceding the World War—customs revenues in the United States amounted to half the government's income. Now, though the customs receipts have grown enormously, they amount to only about 15 per cent of the total government income. In fact, last year the Treasury surplus was greater than the customs receipts. In other words, the government would have paid expenses without any returns from the tariff at all.

The members of the International Chamber of Commerce and the International Economic Conference now have their real work to do—a work of economic education and the securing of political co-operation. To advocate a sudden reduction of all tariffs is unwise, and this is well understood by them, but they should have some success at least in preventing further general increases in tariff barriers. The word "general" is used advisedly, for there are some things on which duties are now too low in countries where most industries are sufficiently or more than sufficiently protected.

Manganese Research and Patriotism

THOSE WHO CLAIM that research into manganese has failed in that no way has been devised of using other than high-grade manganese ores in making steel are seeking merely to persuade the Tariff Commission that there is no point in continuing the tariff which manganese has enjoyed throughout the last five years. The case of manganese is hopeless, they would have the members of the commission believe, and there is no chance whatever of developing a domestic industry. If these representations be true, then by all means let the tariff be abolished. But are they true? These zealots for the removal of the tariff are perhaps a trifle hasty. Blinded by their zeal they fail to see evidence of the progress being made in manganese research, evidence that they might well have pointed out to the commissioners. If there were no other evidence, that contained in a recent bulletin issued by the Experiment Station at Minneapolis would be sufficient to show

that the domestic manganese industry has a case that is far from hopeless. This bulletin describes the progress that has been made in the last few years in the economic study of domestic low-grade manganiferous ores in relation to the iron and steel industry.

This is only one phase of manganese research. There is another phase which has for its object the beneficiation of low-grade manganese ores, such as the rhodochrosite ores of Butte. In such work decided progress is being made, but further time is needed. Removal of the duty would discourage those who are sponsoring this work. Since the provision of an adequate supply of manganese is one of the first considerations in any program of preparedness, it would be most reprehensible deliberately to discourage those who are seeking to provide it.

Truly their enthusiasm has led the zealots for tariff removal astray. The spectacle of such zeal causes one to ask what makes the zealots zealous. Their patriotism, their desire for adequate national preparedness, the answer comes at once. Such a splendid showing of blind unthinking patriotism has rarely been witnessed in time of peace. Is this patriotism unadulterated by a thought of commercial gain?

Safeguarding Investors

APROPOS the Julian petroleum scandal which is exciting the Pacific Coast and which has reached the point where some fifty indictments have been served against brokers, "financiers," and the officials of a prominent bank, the Los Angeles *Times* comments upon the ineffectiveness of the law of California to deal with deliberate crookedness. It states that:

"The launching of a new enterprise depending on public investment for its capital is in the nature of a public undertaking, and if honestly promoted, public exploitation of all available facts could do it no harm. But the public very seldom knows anything about a corporation applying for a permit. The venture conforms to the law, and a deputy corporation commissioner is persuaded that it is meritorious. Personal 'pull' and skillful attorneys are frequently employed in this persuasion. The official disposition is to be encouraging and all the argument is pro-permit. The permit issues and presently a well-organized, high-powered sales campaign is launched, promising profits comparable to those of the Ford company, Bell Telephone, or Standard Oil. The public response is generous, and in the case of ill-considered or crooked ventures the mischief is usually done and millions more of savings gone into the dump before there is time for a warning. The most vicious phase of the high-pressure sales methods of such stock sharpers is that their victims are deluded into believing that the permit to sell stock is a guarantee by the State of the merit of the enterprise. In such cases the blue-sky law does more harm than good.

"If these applications for public investment permits were required to be made under circumstances insuring public knowledge of the facts and requiring that the resources and business and personal characters of the promoters be analyzed, additional safety would surely be offered. The public would acquire more intimate knowledge of the matter and be less liable to capitulate to the glamorous promises of the prospectus."

Adequate publicity has been recognized repeatedly as an essential supplement to blue-sky laws, but unless outside parties take it upon themselves to investigate and to publish the result of their findings, very little is accomplished. It is clearly the duty of the blue-sky commissioners to make and to publish the result of their investigations when they issue a permit. Likewise stockholders should insist upon full reports upon the affairs of the company in which they are interested.

Confidence and trust are admirable in themselves, but some canniness and knowledge of humans is necessary to discriminate between sound and crooked speculations. By turning some of the energy of its staff upon promotion schemes, the *Times* could no doubt materially help to protect its readers from unwise investment.

Sunday Closing

WORD COMES from some of the Western mines that curtailment of production is to be effected by Sunday closing during the summer months. This is an excellent idea that might well be followed by all ore and metal producers who feel that they are victims of overproduction. There are, of course, some operations that are, of necessity, continuous, such as most of those concerned with smelting and refining; obviously, it would not pay to risk the loss of a furnace by banking it over the week-end. Also, there is a certain amount of repair work, pumping, and various odd jobs that require Sunday work. But most mining and milling operations can be shut down for twenty-four hours with loss of practically nothing except the use of the idle equipment.

Time was when almost all mining activities went on continuously for practically 365 days in the year, though hesitating a little, perhaps, on Christmas. Operating officials could get a day or two off, now and again, but the manual worker put in his shift day in and day out, or was supposed to. Sunday was the same as any other day. In recent years, however, there has been less of a tendency to do this. The present weakness in metal prices, with threats of more metal being produced, temporarily, than is being consumed, offers an excellent opportunity to make the Sunday closing as complete and widespread as possible. In fact, during July and August, operators in the northern hemisphere might well consider a five-day week, thus giving all employees more of a chance to assist in the consumption of surplus gasoline as well as helping the metal market.

The Tariff on Fluorspar

NEXT WEEK in Washington the Tariff Commission will grant a public hearing on fluorspar in response to applications made for an increase in the rate of duty on that commodity. These applications were made two years ago in April, and eight months later an investigation was begun. Thus it will be seen that although the tariff may be flexible, its flexibility does not necessarily mean precipitate action in changing it. As a result of this inquiry the commission has issued a fifty-three page report full of facts and figures as to production and consumption, imports and exports, and comparative costs of producing and delivering fluorspar. It is the last that is the most important in this instance, for it is on alleged higher domestic production costs that the plea for a higher rate is based. Thus the issue is clear-cut and not camouflaged as in the case of manganese, where those who plead for the complete removal of the tariff talk about preparedness instead of the real points involved.

From the data in this report on fluorspar, it may be assumed that domestic reserves are ample for domestic needs for a good many years to come. An exception possibly is the reserve of high-grade spar, which apparently is rather limited. This high-grade ore is used in making hydrofluoric acid and its salts, in manufac-

turing artificial cryolite for the aluminum industry, and in producing hydrofluosilicic acid for electrolytic lead refining. The bulk of domestic fluorspar produced, some 85 per cent in fact, is gravel spar, the product of crushing, washing, and concentrating. This finds its principal use in basic open-hearth steel furnaces to correct the pasty consistency of the slag.

Domestic gravel spar producers have in England their chief competitor. Delivered costs of English spar at some of the principal consuming centers in the United States are, on the average, about $13 less per ton than the average domestic cost, according to the commission's findings. It is not strange then that imports have risen from about 5 per cent of the domestic output in 1919 to 60 per cent in 1926. This is what disturbs the domestic producer's peace.

So it is that on Friday, July 22, the commission will sit in Washington to give those concerned a chance to state their views. That body may be relied on to give fair treatment to the interests on both sides.

Prolonging the Life of South African Mines

SIGNIFICANT of how an experienced operating personnel under good leadership will exhaust the mining possibilities of a given area is the work undertaken at the property of the Modderfontein Deep Levels, Ltd., in the East Rand, Transvaal. Development work in the main reef in the company's holdings has been about completed, and ore reserves stand at 4,150,000 tons of an average value of 9 dwt. and stoping width of 80 in. However, for some years the possibilities of hanging-wall "leaders" have been under consideration, and, according to a late report, some 450 boreholes as well as a number of short raises have been extended into the hanging wall from the main reef workings.

Four leaders of probable economic importance have been intersected within a distance of 20 ft. of the footwall of the reef. The leaders are erratic in occurrence and value, but out of 890 ft. of exploratory work a total of 285 ft. is estimated to be payable, the assay value being 7.5 dwt. over a width of 44 in. This appears to be a significant beginning of systematic efforts to extend the life of the South African gold mines. But this is not the only direction in which effort has been made, for success has also attended the pressure to reduce operating costs. As time goes on more and more will the operating cost be the factor limiting the duration of mining in this region. This is generally recognized, and mine managements are directing intensive efforts toward reducing these costs to the minimum. The possibilities are perhaps never quite exhausted, for human ingenuity and good engineering will find new ways even in situations where it is accepted that no additional improvement can be made. The history of mining is marked by sign posts each heralding a change from a static condition to a new order.

The Progress of Road Building

ROAD BUILDING has come to be one of the most important activities of the United States Government, one-sixth of the entire public budget being used for that purpose, according to data compiled by the National Industrial Conference Board. Surely, no one can complain about taxation for this purpose, for the roads have come to be used almost universally by the general public, instead of principally for short-distance market hauling and a few venturesome bicyclists. Only education and national protection absorb a greater proportion of the government budget, the allotment for education, also, being generally above reproach. As for protection, it is hoped that the peoples of the world will co-operate sufficiently to make this huge expenditure unnecessary, though progress seems to be slow.

But to return to roads. Motor highways are not only being built and reconstructed for urban, suburban, and interurban traffic, but are being extended into the most remote mining camp. About a million miles of highways have been built since 1904, and the percentage with a hard surface is now 17 instead of 7, as at that time. Where formerly a railway was thought necessary, a good road now serves the purpose except for the transportation of the heaviest equipment and for serving large camps; in fact, the road is superior in many respects, for by permitting the use of automobiles for pleasure, it removes much of the ennui of life at a lonesome mine. Also, it is an unimportant mine indeed now that does not possess at least one truck, and the economies afforded by good roads in hauling supplies and products are evident. Concrete is generally accepted as being the ideal pavement; the resultant economies in expense for gasoline, and especially for tires and car upkeep, are not generally realized. It is probable that the last two items would be halved if driving were exclusively over concrete compared with a gravel road.

Pacific Coast Steel Companies

RUMORS OF A MERGER between the Columbia Steel Corporation and the Pacific Coast Steel Co., both Western concerns engaged in the manufacture of steel and its products, principally in California, have occurred from time to time, but apparently no foundation for them exists. At least both companies are reported to have denied any intent to form a merger. Nevertheless, such a consolidation is looked upon as a logical outcome. The affairs of both companies are ably administered, and they have succeeded in establishing themselves in the industries of the Pacific Coast. Each company was organized to manufacture a specialty; in one instance it was steel castings and, in the other, power-transmission towers. Both companies utilized iron and steel scrap as raw material, but in 1924 Columbia Steel expanded its facilities and brought a blast furnace into production at Provo, Utah, since when it has produced pig iron for Coast foundries and for its own use in steel making. In the meantime, the Pacific Coast Steel Co. has been investigating iron-ore deposits with a view to establishing furnaces also, but no decision has been announced as to when they will be built.

Both companies are well equipped, and, with low-cost power, have important advantages. Nevertheless, under present conditions they are thrown more or less into active competition and must also compete against the U. S. Steel Corporation and other steel companies that supply Pacific Coast markets. Competition appears to be keen but not destructive, as there is a degree of harmony in the steel business. However, a combining of the resources of the two leading companies of the Pacific Coast would result in some economies and in a stronger financial position.

Ultimately the Pacific Coast will supply much of its needs in iron and steel products, principally because it has low-cost power, dependable fuel resources, and a growing pressure of population which must find its principal occupation in the manufacturing industries.

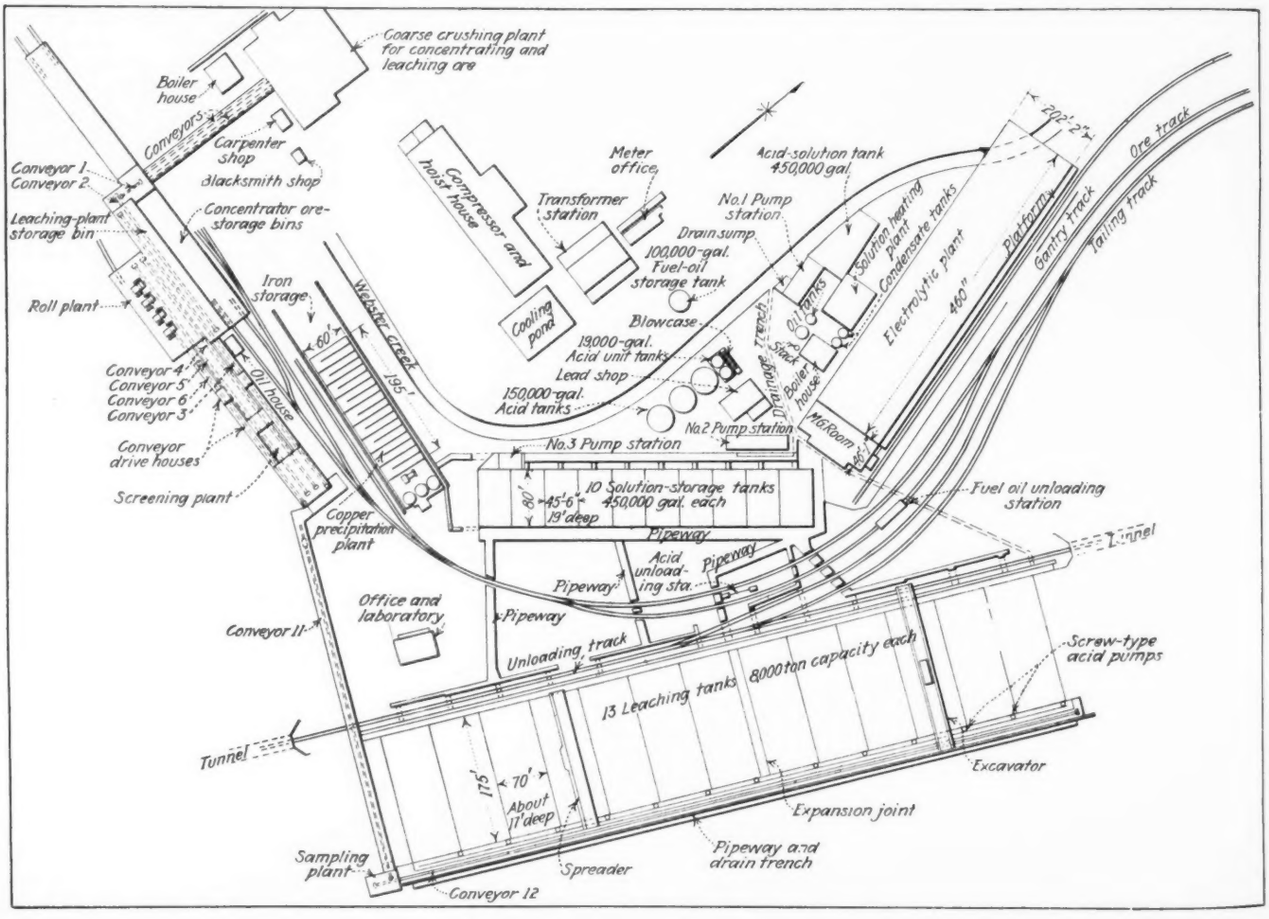
Detailed Costs of Constructing and Equipping the
Inspiration Copper-Leaching Plant

By George H. Booth
Mechanical Engineer, Inspiration, Ariz.

AN ACCOUNT appeared in the *E. & M. J.* of June 4, 1927, describing the concrete work in connection with the building of the 8,000-ton leaching plant of the Inspiration Consolidated Copper Co., in Arizona. The present article is to deal with construction costs.

The accompanying detailed costs may prove interesting, especially the overhead, which was 4 per cent, excluding engineering, which was 4.4 per cent, leaving 91.6 per cent of the total expenditure entering directly into the construction of the plant.

Grading for the plant and the tailing-disposal railroad required moving 369,000 cu.yd., mostly rock. All the work was done under contract. The contractors used electrically driven ¾-yd. shovels and dump trucks, which transported the excavated material to make fills at the plant site and for the railroad grade, the latter requiring hauls of 500 to 3,000 ft.



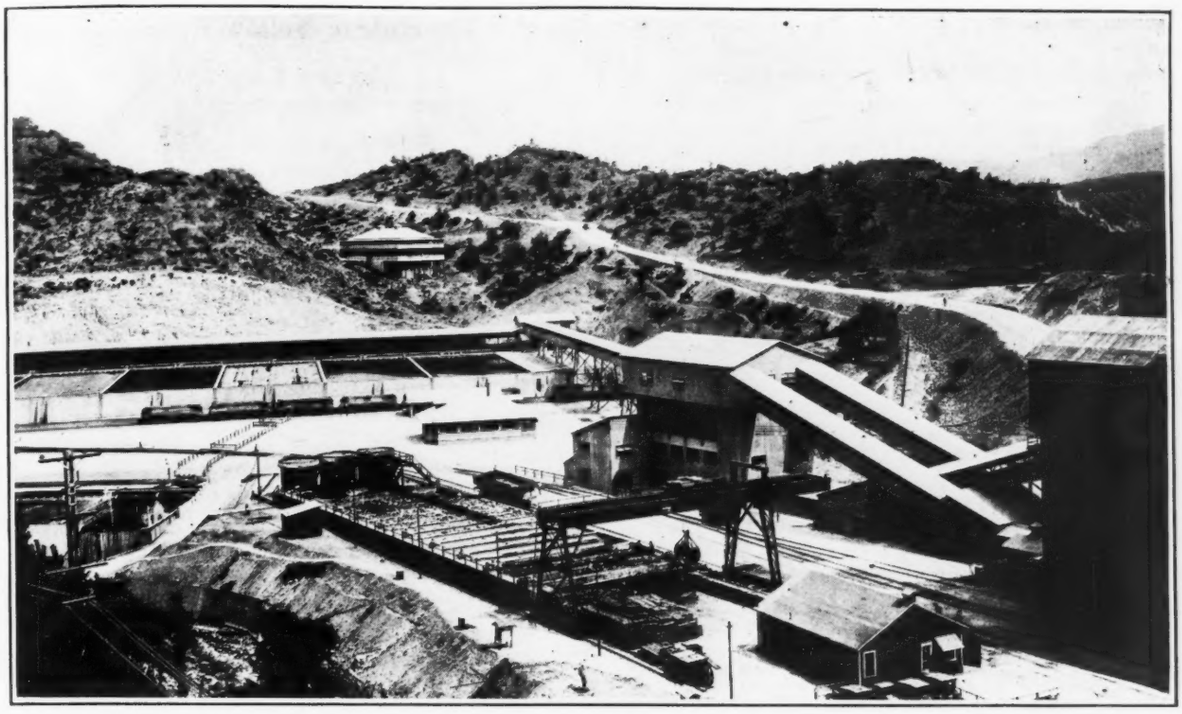
General layout of the plant

A. G. McGregor designed the leaching plant, made all design drawings, and requisitioned material, the orders being placed through the purchasing department of the Inspiration Consolidated Copper Co. The plant was built by company forces under the direction of T. H. O'Brien, the general manager, and is to treat oxide ore, and mixed sulphide and oxide ore as well. Sulphide ore goes to the concentrator as formerly. Before any work was done the estimated cost of the plant was $6,000,000, and the actual cost of the completed plant is $5,840,650, or 2⅔ per cent less, which is unusually accurate estimating for such variegated work. Costs may be divided into three main groups:

Material	$3,840,700
Labor	1,715,750
Sundries	284,200
Total	$5,840,650

The tailing railroad and yard tracks required 2⅔ miles of new work. There were purchased for the tailing haul twenty 45-cu.yd. Magor side-dump cars, and a 113-ton, side-tank, oil-burning, six-wheel, switching-type Porter locomotive.

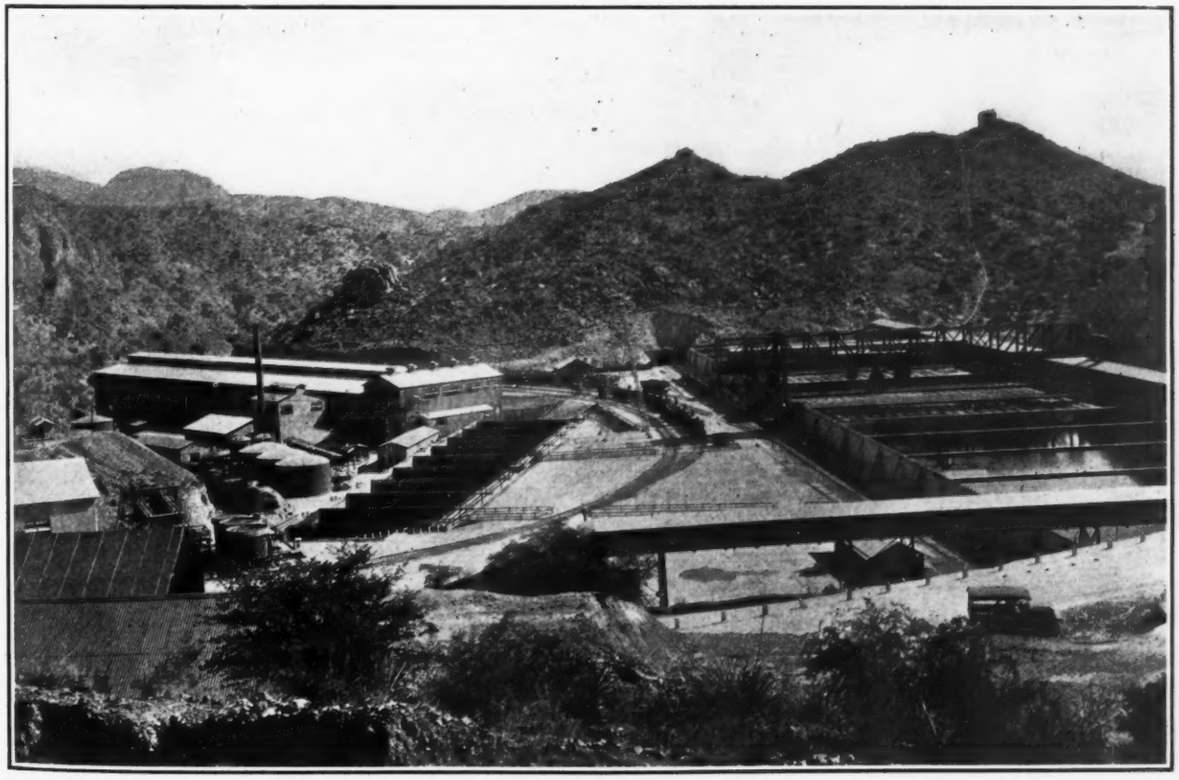
Structural steel going into the various buildings and gantry cranes amounted to 2,650 tons. More than 4,000,000 board feet of lumber was used in the completed structure; also 3,400 tons of lead for vat linings and 550 tons of copper for electrical and other equipment.



Leaching plant looking toward electrolytic tank house

The belt conveyors vary in width from 18 to 48 in., but most of the conveyors are 36 in., their total installed length being over 3,900 ft. Robins Conveying Belt Co. furnished the complete mechanical part of the conveying equipment, including Timken bearing carriers, drives, and six automatic trippers; the United States Rubber Co., the Gutta Percha & Rubber Manufacturing Co., and B. F. Goodrich Rubber Co. the conveyor belts.

The roll plant contains four 24x78-in. Traylor crushing rolls, so arranged that each may be used either as a primary or as a secondary roll. There are twelve 8-ft., Type 39, Hum-mer screens in a separate building, four sizing the ore before it goes to the rolls and the remaining eight sizing the combined discharge of the primary and secondary rolls. The filling bridge and the excavator, with a 15-ton grab bucket, both spanning



Leaching plant looking over "iron" launders toward screening section

the leaching tanks, were made by the Wellman-Seaver-Morgan Co.

In both the roll plant and motor-generator room are 30-ton Shaw cranes with 3-ton auxiliary hoists, and in the electrolytic plant two specially designed 5-ton Shaw cranes with 100-ft. span are installed. A 5-ton gantry spans the iron launders and handles scrap iron with a 2,000-lb. magnet, and sludge as well, with a 1½-cu.yd. bucket.

Cost of Completed Structures at the Inspiration Plant

Roll plant	$404,750
Screening plant	103,050
Conveyor system	263,850
Sampling mill	20,200
Leaching tanks, thirteen	1,394,150
Solution tanks, eleven	368,900
Electrolytic tank house	939,200
Motor-generator house	303,700
Transmission lines and transformers	118,300
Anode casting machine at smelter	19,000
Tailing railroad	283,250
Solution heating	103,550
Copper-precipitating launders	112,600
Acid storage	27,950
Oil house	4,800
Lead shop	18,800
Water supply	57,950
Telephone and signal systems	5,200
Office and laboratory	25,250
Total	$4,574,450

To handle acid solutions there are thirty-nine Byron Jackson lead pumps, twenty-six being horizontal and thirteen vertical, made from special designs. A variety of cast-lead valves—in fact not fewer than 264 in number—were used, including Resisto, United Lead, and Antisell types, in a considerable number of sizes—4, 8, 10, 12, and 14 in.

Cost of Work Not Part of Structures

Clearing site and moving buildings	$89,000
Grading	401,500
Changes in railroad tracks	23,250
Alterations to existing structures	16,550
Construction office and warehouse	9,200
Concrete mixing plant	28,450
Lead work not chargeable to structures	48,400
Construction shops	12,600
Construction equipment and tools	36,950
Temporary electric power lines and power	22,550
Temporary water lines and water	10,250
Temporary telephones	400
Handling supplies	34,250
Crawler crane operations	8,300
Stable expense	13,400
Compressed air	2,600
Miscellaneous	18,300
Total	$775,950

Three Westinghouse motor-generator sets were provided, for the electrolytic plant. A truck-type switchboard and auto-transformers were supplied by the same manufacturer. These sets are each four-unit, four-bearing, 40-deg. rise, 500-r.p.m., with a 6,600-volt, 25-cycle synchronous motor. There are two 6,000-amp. 150/320-volt direct-current generators and one 125-volt exciter.

Overhead Costs of Leaching Plant

Engineering, design and field	$257,600
Supervision and inspectors	89,800
Timekeeping and clerical work	16,500
Testing materials	3,950
Miscellaneous labor, including watchmen	28,150
Fire protection	2,300
Toilets and lavatories	1,550
Insurance and compensation	18,800
Transportation of employees	6,500
Overhead from existing shops	2,850
Proportion of expense for purchasing and supply departments	62,250
Total	$490,250

The Rule of Fellow Employee

By Leo T. Parker
Attorney at Law, Cincinnati, Ohio

WHETHER an employee is entitled to compensation where he is injured as a result of negligence on the part of a fellow employee is a common source of litigation. In the law, fellow employees are workmen none of whom have control over the other. The general rule is that where an employee engaged in a common employment of fellow servants is injured as a consequence of negligence of another employee, the employer is not liable in damages. Therefore, the chief point of discussion in litigations of this nature is whether or not the injured employee and the workman who caused the injury are fellow employees.

In various litigations the following have been held, by the higher courts, to be fellow servants: A blacksmith and a miner. A mule driver and an employee engaging in loading cars. An employee working on a platform and other employees moving material therefrom. An engineer and an employee in charge of firing the furnaces. An engineer and a person in charge of a hoisting apparatus. Miners who work in the same room or stope. A miner and a trammer.

On the other hand, the higher courts have held the following *not* to be fellow workmen according to the legal interpretation of the term:

A laborer engaged in the transportation of ore and a miner. A fireman who attends to a furnace in a mine and a track layer. A miner and a workman engaged in removing drainage pipe from the mine. An operator of a motor car in a mine and an employee who opens the gate to let the motor car pass through. Moreover, a superintendent of a mine, or a foreman, who has charge of men, is never deemed a "fellow workman" of the men under his control.

In a recent case it was disclosed that a workman was injured as a result of negligence on the part of a workman who had temporary authority. The court held the former entitled to recover compensation for the injury because the temporary foreman had control over the workman at the time of the injury. In another case it was disclosed that a foreman who had general supervision of one of several mines of a corporation negligently caused injury to a workman in another mine owned by the corporation. The higher court held these two men *not* fellow servants.

On the other hand, it has been held that a shift boss legally is a fellow employee of the common workman, particularly where both engage in the same kind of work. Furthermore, where it was shown that a miner who, by reason of his advanced age, directed the operation of the other employees, the court held him to be a fellow employee of the common workmen employed in the mines.

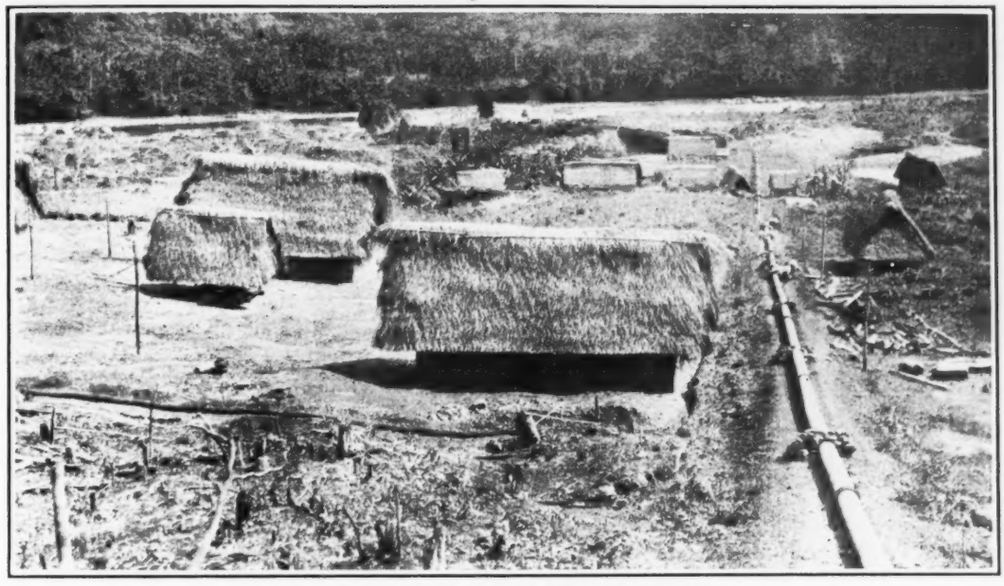
An important point of the law which has been decided by numerous higher courts is that although a foreman or superintendent legally is not a fellow employee of the ordinary miner, yet if he attempts to perform work of the same character as the ordinary employees, and in doing so negligently injures one of the workmen, the injury is deemed to have been effected at a time when the two were fellow employees and the injured man is not entitled to recover common-law compensation for the injuries received.

Rejuvenating a Bolivian Placer

Rio Tipuani Region Once Source of Inca Wealth

By Dwight E. Woodbridge
Mining Engineer, Duluth, Minn.

IN THE DAYS OF THE INCAS gold filled their treasure houses at Cuzco and was the common metal for their gods. Its plenty aroused the wonder and desire of the Spaniards. So was destroyed an ancient and mighty civilization; and so, too, few of those victorious Spaniards lived to enjoy the fruits of their plundering. Like countless other conquerors, they lost their bloody loot along the road. Whence came this flood of yellow metal that stained red the mountains of Peru, from Sorata to the sea, and that overwhelmed the carefully constructed civilization of half a thousand years?



Pueblo of Tipuani, showing the pipe line from a lower canal

Beginning in the year 1535 Spaniards crossed the Cordilleras in several expeditions in search for El Dorado, the "Gilded Man." The second of these journeys was led by Gonzalo Pizarro, who had a far stronger force at his command than that with which his brother Francisco had captured Atahualpa and gained possession of the empire of the Children of the Sun. But all of them, Belalcazar, Quesada, and Gonzalo Pizarro, had those things to contend with which it had been Francisco's good fortune to escape. Intense cold of the mountain peaks that froze the men and their animals, starvation, trackless maze of jagged rocks and dense jungle, torrential rains that rotted their clothing and brought strange diseases, and a climate that, hot or cold, wet or dry, ever was not less hostile than the natives and against which their European armament was no protection. All these things combined to obstruct their quest.

None ever found the country of the Gilded Man, but they did learn that of all the rivers flowing easterly from La Paz Cordilleras, Tipuani perhaps was the richest, and had for ages contributed a large share of gold that had filled the coffers of the empire. This river has its source at an elevation of 17,000 ft., north from the lofty snow-clad summit of Sorata, and forms one of the main affluents of the upper Amazon.

The ridges of the Andes skirt the entire western coast of South America, rising higher and higher as they trend northward from the Straits, until they culminate in the great porphyry peak of Aconcagua, and continue to southern Bolivia as one chain. Here they divide into two parallel ranges, enclosing the high table lands of the Rio Desguadero and Lake Titicaca, whence they pass northward to reunite in that welter of mountains near the northerly extremity of the continent. The eastern range, known as La Paz Cordilleras, or Cordilleras Real, is crowned by Sorata, a snow-clad and glacier-lined peak nearly 22,000 ft. high, lying to the west of Titicaca. Quite recent barometric measurements, by the way, indicate that the alp of Sorata may be some 3,000 ft. higher than the accepted figure. It is only a few miles from the village of the same name, once a proud and mighty city, now a collection of squalid huts. The entire chain of this branch of the Andes differs from the westerly range in that its summits are a succession of sharp and jagged ridges with a fiercely broken stratification.

Gold in All the Streams

This formation is highly mineralized, and the region surrounding Sorata is pre-eminently auriferous. It contains frequently and at high altitudes veins of gold-bearing quartz associated usually with pyrite. It is this section of the mountainous upheaval, particularly on the eastern slopes, that has contributed from time immemorial most of the gold of Bolivia and Peru. Almost anywhere in the streams on these mountain

slopes gold can be washed, but the richer accumulations are on the easterly side. All the rivers which rise upon and between the two mountain chains flow toward the Madeira and ultimately reach the mighty Amazon. Erosion caused by these streams is great, and mountain

A street in Tipuani

sides and veins are loosened, washed onward and deposited in the quieter waters of the lower regions. While all the rivers descending into the Beni thus carry gold, it is a well-known fact that the Rio Tipuani is particularly productive, and has been so for ages past. There is the evidence of almost innumerable records to show this to be true.

In these Bolivian Cordilleras the gold occurs in lodes, but practically all that ever has been recovered by man has been secured from *lavaderos*, or the washings of alluvial deposits in the beds or along the banks of such rivers as the Tipuani. This stream seems almost an ideal locality for these fluviatile placers. Below its most rapid descents from the summits where it rises, it forms a chain of deep and quiet pools, linked by rapids and falls, hemmed in by steep hills or high canyons, and opening often into basin-shaped valleys where the current of the river slackens. It is in these many pools that eroded material transported from the upper reaches has been spread out and deposited, built into layers with a partial concentration near bedrock, and at last has formed the playas, or banks, as they now exist. These upper banks carry gold in varying but frequently pay quantities for many feet in thickness.

Circuitous Journey to Mines

To reach the pueblo of Tipuani is, even today, a serious journey. There are two routes as far as La Paz, one direct by rail from Arica and another from a Peruvian port to the shore of Lake Titicaca, which is at once the greatest body of water in South America, and, with its altitude of 12,500 ft., one of the highest in the world. Like the lakes upon which the city of Mexico was built, it is drying up, very gradually indeed, but none the less steadily. Towns that during the time of authenticated history were on its banks are now inland. Ruins of cities more ancient than tradition lie along its diluvian shores. If one takes this route, he crosses the lake by steamer and enters Bolivia, where another railway, notable for its scenic grandeur, carries him to La Paz. This is the capital city of the republic, a busy and attractive Spanish place of 140,000 people, set in its deep mountain-rimmed bowl.

From La Paz a trodden mule trail, 80 miles long, on which automobile trucks can move more or less speedily, takes one to the village of Sorata. That is the end of any possible vehicular transport. There one switches to mule back. Beyond Sorata the traveler crosses the main divides of La Paz Cordilleras at altitudes varying up to 16,000 ft. If he is not accustomed to such rarefied atmosphere as exists there, he suffers intensely from *sorache*, mountain sickness, that affects him as might a very aggravated form of seasickness. No man with a weak heart should attempt that trail, and the condition of his stomach will be diagnosed automatically.

There are from the passes along this route, themselves almost summits, many magnificent scenic panoramas; words fail to describe them. Language is impotent. The vast scale on which nature has been at work is evident in all directions. It is a sublime assemblage of snowy peaks, glacial cirques, jagged summits of dark rocks lying between the white of the snow and the intense blaze of the sky. Vast forests lie in the lower distances, *montañas* stretch themselves infinitely, great plains, and rivers white with the foam of their tremendous descents. The peaks rise "ramp on ramp into the infinite" and the mind is oppressed by the ineffable.

Mule-Back Transportation

The traveler may then go down the Tipuani, or he may continue on his well-tested mule to the Mapiri, and then shoot down that stream on a flimsy native raft of cane. How difficult all this travel is may be better understood when I say that it takes a week of hard journeying to get from Sorata to the mines, though the distance as the crow might fly is only 40 miles! The path is typically Andean; I can think of no comparison for it in North America unless one has traveled along the coast range, say in the upper Snohomish country, or into the Quesnel, in the older days, and this in the depth of winter; or made his way among the *barrancas* back of the west coast of Mexico. As a matter of fact it is worse than any of these. It is crooked in the extreme, doubling on itself so that one goes miles to accomplish a few rods; it is up and down, down and up, mountain or canyon incessantly, narrow and too dangerous for any animal but the sure-footed mule. From La Paz to Tipuani is about 60 miles in a direct line—such a course as an airplane soon may follow. How far it is today I really cannot estimate—perhaps 150 miles.

The placers of the Tipuani have been worked from very ancient times and what they may have produced is unknown. Since the days of the Incas, operations have been conducted by men from many countries, but always under the great drawback of lack of continuous water. Authentic records date from as long ago as 1533, but long before that time thousands of Peruvian Indians worked there periodically, taking advantage of times of ample flow, and sent their gold across the Cordilleras to their sovereigns at Cuzco. The remains of these *antiguas* are numerous; old ditches are being discovered continually, and tools, coins, charms, and the like, dating from before the conquest, are today dug from washings conducted in the villages, along the ancient streets. When the Spaniards came into possesion, in the middle of the sixteenth century, they carried on work at considerable elevations above the river. Evidences of what was done for them by Indian slaves are to be seen for miles. There are ditches, tunnels, sluices, excavations, and great dumps of barren boulders. Their opened pits were large. They are now

filled by tropical vegetation; sometimes trees several feet in diameter spring from the midst of their pits.

After the Spaniards, for many years these placers were abandoned, but subsequently they were worked by companies from Portugal, France, Belgium or elsewhere. Within a century Don Ildefonso Villamil, of Sorata, made himself a millionaire from these diggings. All these people suffered from the seasonal flow of the rivers. It seemed impracticable to tap any continuous water supply except at a cost that no one was brave enough to undertake.

Plans to Supply Ample Water

Some twelve years ago G. W. Schneider, a mining engineer from Denver, became interested in these placers and secured the aid of capital in New Orleans. At once he planned to do what for four centuries had been thought impossible—that was to divert water from the upper reaches of this river and its tributaries in sufficient volume and under a head great enough to allow a more continuous operation. A great deal of money was spent, but, unfortunately, results were not as satisfactory as had been hoped; water still was seasonal, although the periods for washing were lengthened. Furthermore, it was found that the presence of enormous quantities of boulders embedded throughout the coveted playas made it very difficult to get to bedrock and required so large a force for their removal that labor for the work could not be found. But the owners were not deterred; they had learned that these areas had a value in gold running from about 50c. to as much as $2 a yard and with still better values toward bedrock, and they discovered that quantities of black sand débris carried a high percentage of the precious metal. Recently these people have obtained possession of practically all the river beds and playa grounds between the canyon walls along the river for a distance of many miles. They have been extending their series of ditches and tunnels to tap waters of snow-fed rivers some distance above alluvial ground, and they now feel that there will soon be enough water at sufficient pressure to carry on continously and on a large scale. Money has been and is being spent freely in this development, and the company seems to be on the way to ultimate reward. The aim is to reach a minimum of say 5,000 in. of steady water for sluicing at elevations that will permit the operation of hydraulic elevators to handle the boulders, and for other machinery.

Electric Power at Tipuani

This little pueblo of Tipuani off there in the jungle below the mountain peaks is now lighted by electricity, has a telephone system, and a sawmill and machine shops in which material for the metal pipe lines is assembled. As all this machinery, steel for the hydraulic lines, cement, material of every sort, has come in over these mountains on mule-back, it has been imperative that no single item shall weigh over 145 lb. or be more than 3 ft. long. This has necessitated redesign of much machinery, has added to the complexity of the project, and has increased costs.

There now are some 26 miles of ditches, and in their construction it was necessary to drive not fewer than thirty-one tunnels, some of them up to 1,000 ft. long. These ditches have a uniform gradient and are cut into the flanks of the mountains, curving around their sides; they are built up with rock cemented by concrete or by the blue clay common to the region, and are floored by boulders smoothed with this same clay.

Predominating rock of the region is a hard, blue clay-slate, slightly ferruginous, and with its stratification tipped until it is almost vertical. It exists in vast areas along the slopes of La Paz Cordilleras, and is the cause of the great difference in contour between this eastern range and the mountains nearer the coast. This slate is overlain on the lower slopes by shales, conglomerates, clays, and reddish-brown soil of tropical fertility. Often the river has cut through these later rocks down to the slate beds, and the latter appear piercing through its waters. The country is traversed by gold-quartz veins throughout the watershed, not only of the Tipuani itself but also of its tributaries and other neighboring streams; and placers are found high up these small valleys and in gullies on the slopes. This gold could not have come from the main rivers below. The Tipuani now flows many feet above its original bed and often not at all in the course of that bed, which has been filled by material transported from above, all of which material carries more or less gold. At times there is an upper bedrock, consisting of an irony conglomerate called *cangalli*, and yet above this are still later false bedrock strata. On the true bedrock is the main pay-seam, and it sometimes runs to 3 or 4 ft. in thickness and occasionally carries up to an ounce to the pan, although its average is far less. The upper and subordinate hard seams show a concentration, though leaner and thinner than the lower. Above these harder seams—these false bedrocks—are the surface playas. They run from a few feet in thickness to 50 or 60, and they contain gold at not less, so far as I am able to say, than about 50c. a yard. Average washings seem to be better than this.

A Traditional $30,000,000

There is one playa called the Roman, situated a dozen miles or so up-river from Tipuani village, that has a famous history. It lies in a little recession of the hills

Negro panning gold

with the river forming the chord of a semicircle, and covers about 50 acres. Of this area part was washed in the olden days, and out of the ten or fifteen acres so treated it is tradition that not less than $30,000,000 was taken. Scattered about this bench are to be found

all sorts of ancient tools, chiefly of wood and stone; the remains of ancient ditches run down into it, human bones are mixed in the soil, emblems of various sorts, mostly of gold, are to be found. Some of these resemble the swastika cross; others are charms and amulets of Spanish origin; others are of an unknown nature and design. In the washing of such grounds the company has recovered perfectly rounded beads of gold, pierced for a string, and these no doubt at one time formed part of an ornament around the neck of some princess of the Incas or ingratiating local Phryne. Spanish silver coins of the sixteenth century are found in the sluice box or *batea* of native workers. These coins bear the inscription of Charles Fifth, but none that I have ever seen are of so recent a date as Philip the Second. They had come from Spain, eluding the vigilance of English privateer, across the Isthmus, down the west coast to Peru, and over the Andes with Pizarro or others of the argonauts.

Gold Is Exceptionally Pure

Gold found along this river is peculiarly pure, sometimes up to 980 fine. A little less than 29 lb. taken to mint at New Orleans recently was paid for at the rate of $226 per pound, after deducting the trifling mint charges. It occurs as flat or angular coarse grains, thin plates, somewhat rounded grains, all of a deep yellow with very little silver admixture. Large nuggets seldom are found. It is comparatively easy to save because of its size and because there is so little flake gold. Occasionally grains of platinum are found in clean-ups.

It is evident from the appearance of the old workings that most of the millions recovered were from upper levels, and that bedrock seldom was reached. The difficulties with cemented conglomerates, with innumerable boulders that could not be handled, with periodic rises of the river, with lack of usable water most of the time—all these things added to the problem of getting to the bottom of the stream troughs. It also is clear that enrichment is going on continually, for ground that once was washed is rich enough to wash again. Some of the tailing dumps are rich enough to pay, showing how careless were the uninterested Indian workers and how crude their methods. Timber was plenty, but it was not used much, and there were no underground approaches to the richer levels. All work was from pits. These were made by stripping off the lean soil and boulders, and the deposited soil afforded such easy percolation for water from the river, and itself was of such a nature that laborers were hindered and occasionally were buried alive by slides of earth, rock, or silt. These slides reduced the workable areas of their pits. Today, these diggings are full of masses of rounded rocks. Present-day methods will eliminate some of these troubles.

Labor Presents Problem

A difficulty has been labor. It is so today. The taskmaster of the Incas had often, it is related, upward of 1,000 men at work. Even so recently as in the time of Don Ildefonso, in the last century, he had as many as 500 of them washing the Tipuani.

Now the company finds it hard to maintain more than 100. Good accommodation has been provided, supplies are sold at reasonable prices, the pay is average, and the district is not unhealthful as these *montañas* go, but men are hard to secure. Wages in that general region are up to about two Bolivianos a day, which is to say from 60 to 70c. gold, and this is what the company pays. It will require a campaign of fair dealing, decent pay, and the co-operation of the rulers of the state, continued over a considerable period, to overcome the handicaps that must be met and enable these placers to show what they can do under favorable conditions.

Fortunately, Victor J. Wallin, president of the company and its manager, has approached this problem of labor in a way that should give results. He realizes that cheap and abundant food of a proper sort will assure contented workmen and a lower labor turnover. He has established a company plantation and has devoted a large acreage of rich bottom lands to the production of five chief food crops. These are corn, cane, a variety of rice that does not need irrigation, bananas, and Bolivian *papas*, which is the humble forebear of the ubiquitous Irish potato. This tuber has the valuable property of remaining in the ground for several years after ripening without deterioration. Mr. Wallin has employed a competent plantation foreman to supervise this work and hopes to raise food enough for a large crew of men and their families. Another innovation is a departure from the old-time policy of "treatin' 'em rough." Really it is quite a radical departure from traditional methods, and it is Mr. Wallin's fond hope that it will increase efficiency. On Sundays, after morning mass in a church erected by the company, he gathers his foremen and chief laborers around the dinner table and they discuss together their work, their problems, and their several accomplishments. Already this has improved social conditions and raised *esprit de corps*. It should help to make Tipuani a place where men will go and stay.

Workers are recruited from the Ayamara and Quichua Indian tribes, for the most part quiet and tractable men, short of stature and stoutly built, but many are dull of eye and hopeless of expression. What will these superstitious mountain Indians think when, before long, they hear the radio and see their superintendent send his voice into the air, talking with people in countries of which they have never heard! There are a few negroes who are descendants of slaves brought up the Amazon by the Portuguese who once worked these mines.

Coca Not Cocoa

Mr. Wallin has arranged that a regular supply of coca shall be furnished free to the men. To anyone who has spent time in Chile or Peru the value of this leaf as a food and stimulant need not be told, for no doubt he often has used it when worn out by bodily or mental fatigue or when lacking other foods. Its use as a regular article of diet is widespread throughout all those regions, and there seem to be no ill effects from its steady consumption. On the contrary, it is a stimulant perhaps without a superior, giving no depressing reaction, and it is not habit forming. It is a food on which one can labor for days. Coca is given the men at the rate of an ounce per day. Coca chewing, usually with a little lime reaction, has been general among these Indians for countless ages, and is common now. Coca is not to be mistaken for cocoa, or chocolate, for it is altogether a different genus.

If the history of these Tipuani placers is any guaranty for the future, and if appearances do not deceive, this district will again be heard from as a considerable producer of gold.

With the Geologists in Spain

Concluding Installment

Tharsis—Geology of the Huelva Mines—Seville—The Congress at Madrid

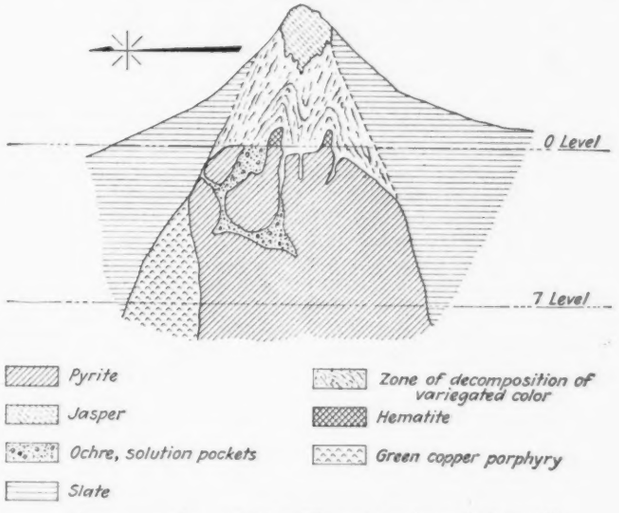
By T. A. Rickard

ON THE DAY of the excursion to the Tharsis mines we had the proud satisfaction of seeing a sunrise—unwillingly—for we had to make a start at 5:30 a.m. The train filed through the estuarine marshes of the Odiel River and then across the coastal plain. A large plantation of fig trees showed splendid foliage; then we passed a handsome vineyard on one side and a moorland on the other, suggesting how the industry of man could assist nature to fruitfulness. Later, young pines and barley fields gave diversity to the landscape, which became more severe in its aspect as we gained altitude on our way to the hills in which the mines are situated. Scant scrub and esparto grass, with scattered oaks, replaced the fruitful verdure of the lowlands. The little white town of Alonzo, on the crest of a hill, caught the rays of the early morning sun, and in the middle distance the stump of a tower on a rocky escarpment whispered tales of border warfare. The oak of the region, the evergreen ilex, in parklike order reminded us of the Californian foothills. A further gradient brought us to the top of a ridge from which we caught sight of the tumbled hills of the Sierra de Aracena, which serve as an approach to the Sierra Morena, a dissected peneplain. The rounded slopes are covered with a small green bush, with a white flower, named the *jara*, which takes the place of the Californian chaparal. The *jara* is the gumcistus, or *cistus ladaniferus*, the source of the ladanum gum as used in pharmacy. Herodotus mentions how the gum was collected in Greece by driving goats through the bushes, their hair being subsequently clipped, so that the ladanum could be distilled therefrom.

We alighted from the train on the very edge of the Corta de la Zarza, one of the big open-cuts of the Tharsis Sulphur & Copper Co., whose chairman and managing director, W. F. Rutherford, welcomed us cordially. This company is even older than the Rio Tinto, for it was registered in 1866 at Edinburgh, although it is distinctively a Glasgow enterprise. The Scottish company bought the mine from a French proprietary that had worked it unprofitably for twenty years.

The La Zarza excavation is an impressive hole 850 meters long, 280 meters wide, and 188 meters deep to the seventh level, which is the bottom of the pit. The eastern end of this open-cut extends into a hill known as Cabezo de Los Silos, where an interesting geologic section is exposed to view, as shown by the accompanying drawing, which I owe to the courtesy of Mr. Rutherford. The impressiveness of the sight is accentuated by the steepness of the sides of the huge excavation, the slope being at 70 deg. on the edge and 45 deg. in the ore itself. Looking eastward, the enormous void appears in all its grandeur. A hawk flies across the abyss to a nest in the upper cliff. Here a crest of red jasperoid rock serves as a Republican cap for the bleached Tory shale, the gray pyritic ore penetrates the dark shale underneath, and the greenish-gray porphyry is disclosed upon the flanks of the orebody northward.

The ore between the seventh level, or bottom of the open-cut, and the tenth level, 45 meters below, is now being mined. Development work is in progress on the 14th level, which is 60 meters below the tenth. The

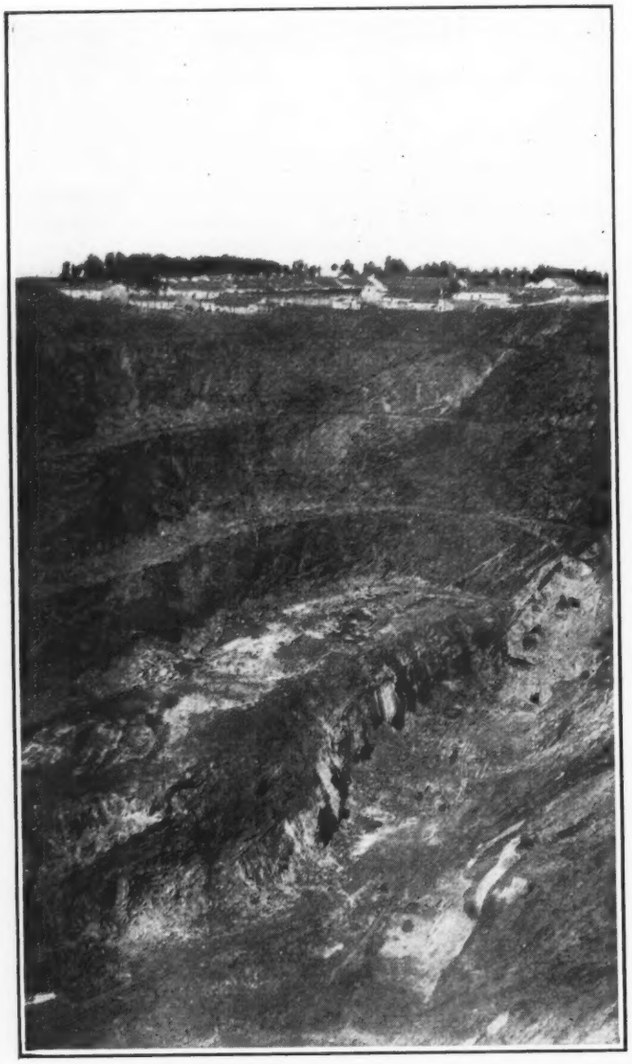


Cross-section of the Tharsis mineral deposit

known length of this orebody is 2,000 meters, but it continues strongly eastward, for a distance yet to be ascertained. The estimated reserves in the La Zarza are 50 million tons, but this tonnage may be increased by further development eastward. Borings made by a neighboring company on the adjoining Perrunal mine prove the persistence of the orebody to a depth of 900 ft., the top of it being 121 ft. below the surface of the ground. The copper content is 0.7 to 0.9 per cent, with 50 per cent of sulphur.

The geologic conditions resemble those of the Rio Tinto mines. No inclusions of porphyry appear in the orebody. Enrichment with chalcopyrite is observed at the edges and near the surface. Slickensides are seen in the pyrite itself. A *cardiopteris* fossil found on the plane of a fracture in the shale suggests the lamination of this Carboniferous rock. At the east end the orebody on the lower levels is in the porphyry, but overhead it lies in shale, the line of the top of the pyrite being remarkably horizontal. Along the edges of the pyritic mass one finds veins of quartz. In the lower workings the ore still contains about two grams of gold and 40 grams of silver per ton, with only 1½ per cent silica. On the north side, inward, there appears to be a graduation from clean quartz-porphyry to a sprinkling of pyrite, and then to solid pyrite. On the

shale side, however, there seems to be a clean demarcation from shale to pyrite. Therefore replacement by hydrothermal agency is suggested, but I mention this timidly, because I happen to know that C. Gilbert Cullis, professor of economic geology in the Royal School



The La Zarza pit, or Los Silos open-cut at Tharsis

of Mines, London, was at the Tharsis mines two years ago, and he, while unwilling to accept the evidence available as conclusive, favors the theory of a pyritic injection rather than that of a hydrothermal replacement; to him the orebodies appear to be more akin to igneous rocks than to metasomatic replacements. "The ore is as massive and pure as metal," says he, "and does not contain residual rock fragments." Similar opinions are held by E. Broughton Edge, who has spent considerable time in investigating the Huelva region. My American friends and fellow excursionists, who spent only a few hours at the mines, will, I feel sure, be slow to offer positive conclusions.

After our inspection of the Zarza mines we were tendered a sumptuous luncheon, at which Mr. Rutherford made a delightful speech of welcome. Afterward we went to the old Tharsis group of mines 20 miles southwest, where another great opening into the crust of the earth, the Corta Del Norte, has been dug in search of copper and sulphur. The open-cut is 670 meters long, 230 meters wide, and 110 meters deep. The orebody is as much as 120 meters in width. This lode is estimated to contain 65,000,000 tons of first-class sulphur ore, but the progress of development has been halted for the present by reason of the cheaper sources of supply that have been developed in the United States.

At Tharsis, as at Rio Tinto, there is a large accumulation of Roman slag, which is said to contain 0.35 per cent copper. On the South Lode a million tons of this slag is lying on the surface, and it is mixed with gossan containing enough gold and silver to invite re-treatment. Some of the slag contains 0.5 per cent copper. Small cupolas, furnaces of a rudimentary type, have been found, resembling those used by the primitive Japanese, as described by Gowland.[1] Extensive ancient workings penetrate the upper portions of the orebodies, which are oxidized to a depth of 200 ft. In these some Roman water-wheels have been unearthed.

The Tharsis company's capital is £1,250,000, in 625,-000 shares of £2, now quoted at slightly over £3. This company has made gross profits of £16,599,111, of which £11,307,260 had been distributed as dividends up to the end of 1925. The present capital of the Rio Tinto company consists of 325,000 5 per cent preference shares of £5 each and 375,000 ordinary shares of £5 each, making a total capital of £3,500,000, on which the company had distributed £38,695,000 in dividends up to the end of 1925. The ordinary shares are quoted at about £40. To ship sulphur ore profitably a distance of from 2,000 to 4,000 miles, to England, Germany, and the United States, in face of the competition of the native sulphur that is so easily extracted in Texas, appeals to one as a highly creditable performance.

From the Tharsis mine one can see eastward the smoke of the Rio Tinto smelter, 20 miles away. No mines of importance have been developed within the intervening territory. The hills to the southwest were indicated to me as the site of Tarshish, from which the name Tharsis is derived. The Tarshish of the Bible and the Tartessos of the Greeks was the capital of Turdetania, which became the Roman province of Baetica and is now the Spanish Andalusia. Tarshish was near Cadiz, the Phoenician Gadir, and the Greek Gades, at the mouth of the Guadalquivir, which the Romans called the Baetis. Therefore Tarshish was not anywhere near the modern mines that have borrowed the name; it was so utterly destroyed by the Carthaginians, in order that Gadir might take its place as a centre of maritime trade at the western extremity of Europe, that its former site was confused with that of its successful rival. When Carthage was destroyed, in 146 B. C., sixty thousand of its inhabitants were sent to labor as slaves in the Spanish mines, of which, not long before, the Carthaginians had been the opulent masters. When the Tharsis company was building a new shipping pier at Huelva, and dredging for increased depth, there were found, 15 ft. below the top of the silt, several hundred implements and ornaments made of bronze, evidently the lost load of a ship that had been sunk there. The question arises, was this bronze being exported or was it being imported? The copper ore of some of the veins in the Huelva region, such as those of Parazuelos and De Campo, contains tin, and it is possible that in the course of metallurgical treatment the proportion of tin to copper might be increased to the composition of a

[1]William Gowland; "Archaeologia," Vol. LVI, p. 294. These and other writings by the late Professor Gowland are the best extant on primitive metallurgy.

true bronze, say from 5 to 10 per cent of tin and 95 to 90 per cent of copper. The copper produced from the ore mined in the two localities mentioned contains 0.4 per cent tin.[2] This offers an alternative to the supposition that the bronze came from the eastern Mediterranean.

Before leaving these references to antiquity I must record the finding, in 1772, of a copper plate inserted in the wall of an adit at Rio Tinto. The plate bore the following inscription:

IMP. NERV. CAESARI AVG.
PONTIFICI MAXIMO. TR.
pOTEST. P.P. COS. III
desiG. IIII. PVDENS. AVG. LIB.
pROCVRATOR
de suO. POSVIT.

The small letters indicate the restoration of missing parts. This writing has been amplified by Wilmanns as follows: Imperatori Nervae, Caesari Augusto, Pontifici Maximo, Tribunicia Potestate, Patri Patrae, Consuli tertium, Consuli Designato quartum, Pudens, Augusti libertus, procurator, de suo sumtu posuit. The translation reads thus: "In honor of the Emperor Nerva, Cæsar Augustus, Pontifex Maximus, vested with tribunician powers, Father of his Country, thrice Consul, and Consul Designate for the fourth time, Pudens, a freedman of Augustus, the manager (of the mines), erected (this tablet) at his own expense." The references to official positions prove that the inscription was made in 97 A.D.

Eucalyptus is being planted, from seed, for the purpose of growing timber to be used in the mines. Maturity is reached in fifteen years, and the mine managers only regret that they did not start this useful practice earlier. In Sardinia, so Charles W. Wright told me, the cost of producing a young tree from seed and transplanting it (six months old) was 35 centesime, before 1914, or 7c. American. The increase in value thereafter is 10c. per annum, and maturity (when the tree is of 8 to 10 in. diameter) is reached in ten years, by which time the trees, as they stand, are worth one dollar apiece. This eucalyptus timber has proved better in the mines than pine, because it is less susceptible to fungus.

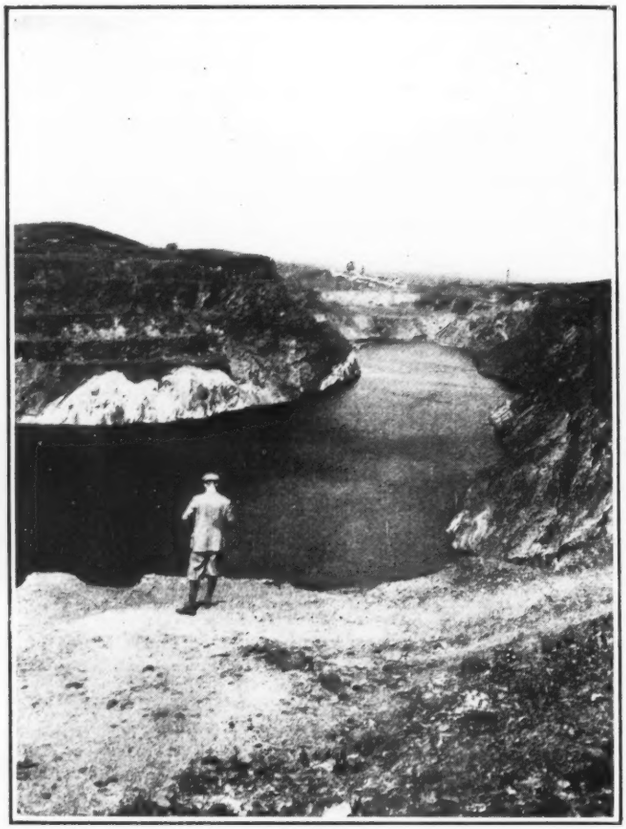
We left Huelva on a rainy morning in two large motor buses on our way to Seville. The road was wet, winding, and hilly, so that we traveled "in second" most of the way, which made the journey slow and noisy, but even this failed to dampen the enthusiasm of the hammer-men, who alighted several times to chip the rocks and discuss the local geology in a lively manner. At the start we traveled across the coastal plain, to which barley fields, fig groves, and vineyards gave a gentle touch. On the Cerro de Los Angeles, near Alajan, we passed near a picturesque village on a hill, half hidden by oaks, fig trees, and chestnuts. The roadside was overhung with grape vine and honeysuckle, and on the banks were roses, golden glow, iris, pink gladiolus, and asphodel, making a lovely picture of May blossoming. Then we found ourselves amid rolling hills covered with the *jara* shrub. To these succeeded the uplands clad in heather, 2,000 ft. above the sea. At 41 kilometers several geologists alighted to examine a diabase outcrop, and a few kilometers farther they stopped to investigate a mass of manganiferous jasper. At about 75 kilometers the moorland changed to a park country of oak and brush, including the *planta genesta*, or broom, in yellow flower. The rain restricted our view but freshened the foliage. We enjoyed our luncheon while *en route*, each passenger having been provided with a bag of comestibles, to which sundry bottles of *vino rubio* gave the requisite flavor.

At 5 p. m. we reached Aracena, where we were received by the Mayor of the town. Here we visited the celebrated grotto, which is ornamented by stalactites that are illuminated by electricity. Leaving Aracena we passed several carts loaded with bark, and shortly thereafter we saw the trees that had been decorticated. The

The La Zarza pit, looking toward the Cabezo de los Silos, at Tharsis

[2]Louis Siret; "Les Premiers Ages du Metal," page 214.

cork comes from a species of live oak, the *quercus ruber*. The rain fell heavily for an hour; then we drove through a park-like forest of oak between which ranged clusters of palmetto, and on the roadside were many bushes of oleander in full bloom. We passed many carts, heavily loaded, and pulled by mixed teams of horses and mules, led by a donkey; the "Colonel," this sagacious little fellow is called. The clouds lifted, and the sun shone gladly on a landscape washed clean. Then we crossed a stretch of moorland, from which, descending along a winding road, we looked down upon the



The south pit of the old Tharsis mine, full of water

broad green valley of the Guadalquivir, with the towers of Seville dimly discernible on the northern horizon.

Seville, the Sephila (plain) of the Carthaginians, the Hispales of the Romans, and now the capital of Andalusia, is on the Guadalquivir, the name of which recalls the Moorish domination. Guadalquivir means Rio Grande, or Great River, the original form being Wâd-al-kebir. The root *gua* in Moorish means water; it appears in many Spanish names both in Iberia and in Mexico, such as Guanajuato and Guadalajara.

At Seville, where we foregathered at the Hotel de Inglaterra, we met other delegates to the Congress that had returned from an excursion to Morocco. It was at Seville, on March 31, 1493, that Columbus was received in triumph upon his return from the discovery of the New World, and it was hither, after the French took possession of Hayti, that his body was brought for sepulture, to rest appropriately in the great cathedral.

On the morning after our arrival the delegates assembled at the Municipia to be welcomed by the Mayor of the city. He made the usual conventionally felicitous speech in Castilian, much to the gratification of the assembled company; in the parlance of Arizona his remarks may be translated roughly as meaning that he was tickled to death to have us in the ancient city of which he was the chief municipal officer and he proposed to break his neck in an effort to give us a good time! Suitable responses were made in Spanish and English, after which we went our ways sight-seeing.

Some of our party ascended the Giralda, the oldest building in Seville, built as a minaret or prayer tower by the Moors in 1196. It was only a short walk from the Municipia along an alley between whitewashed houses to the cathedral, which was built in the years from 1402 to 1506. The exterior of the cathedral is a mixture of Gothic and Moorish architecture, but that does not detract from the beauty of the interior; it is like the typical Spanish home, with its plain outer walls, and heavy carved door, through which one enters into a patio, where the true face of the house is turned inward to its dwellers. The cathedral at Seville is, I believe, the largest Gothic structure in existence, but the size is of no consequence save for the spaciousness and perspective that result therefrom. Fortunately the chapels are half hidden by the grill-work, and likewise the pictures and statues are lost in the dim light, so that the majesty and simplicity of the vast interior lose none of their impressiveness. The impression is one of solemn mystery, of peaceful dignity; we stand in a temple not made with hands, a place for worship; the soul of a Pagan or of a Presbyterian alike responds to the spell of this glorious edifice. The fluted columns rise from the marble floor like giant trees to the roof, whose interlacing arches suggest the branches in those primeval forests from which Gothic architecture derived its inspiration.

In the afternoon some of us went to the Alcazar, the palace of the Moorish kings, built in 1360 on the ruins of a Roman Prætorium. The graceful columns, the brilliant mosaics, and the sunlit courts, empty save for one or two visitors, suggest that if architecture be frozen music then this lovely structure answers to the strains of Mozart. From the palace we wandered into the even lovelier, because living, gardens. The sunlight shining through the leaves of a heavily laden orange tree, the leaves golden-green and the fruit reddish-gold, made one dream of the Hesperides. The hybiscus in bloom under an acacia and the lantana spreading itself gorgeously over the garden wall reminded us of California. Another remarkable display was a purple bougainvillea over an arched entry, the bougainvillea being flanked by white lantana and white trumpet vine, both in full flower, and above them the rusty iron grill-work of old windows with carved arches and carved sills, leading to a tower of brown stone—the brown in contrast with the purple—a chromatic symphony!

Later we strolled along the famous Calle de las Sierpes, a narrow but populous avenue named after the snakes on a tavern sign. No carriages are admitted to this street, so it has become a favorite evening promenade. Then tea at the Madrid.

We left Seville on the morning of May 22 and reached Madrid at night. Most of the day we passed through a country beautifully cultivated with vines, olives, and bean. It was late spring, and the landscape looked its best. It seems uneconomic to devote so much land to the cultivation of the vine.

THE FORMAL OPENING AT MADRID

On May 24 we attended the formal opening of the Congress by King Alfonso, who was accompanied by General Primo de Rivera, the Prime Minister and "head

of the military directorate," or Dictator. As the King entered a voice called *Viva Il Re!* to which the assembly, rising to its feet promptly, responded with a single crisp *Viva!* Behind the King and his Minister came the official representatives of the several countries. When all were seated, the outgoing president of the Geological Congress, a Belgian scientist, in evening dress, delivered his annual report, in French. Then followed the new president, Señor Rubio, in levee costume, speaking Spanish. The Secretary of Commerce made a few remarks. Thereupon the King, who was obviously bored by the speeches, said, in sharp military fashion, "The Congress is open." He rose, bowed, and went forth. Somebody called *Viva Il Re,* to which again there came response a unanimous and stacatto *Viva!* The affair was over. Outside the King halted and mixed informally with the delegates in gracious fashion, for a few minutes. As might be expected, our mixed international assemblage exhibited every sign of sartorial chaos, from levee dress to gray sack suits, and even a dinner jacket. Most of us wore either morning coats, evening dress, or academic costume. The wall behind the platform was covered with a big red curtain bearing the Royal Arms, and this was repeated in numerous other hangings around the chamber, with pleasing effect.

In the afternoon we had the choice of going to a bull fight, horse races, or a football match. I would walk 10 miles not to see the stupid brutality of a bull fight, I would not walk a block to see a horse race, but a good football match was attractive. Several of us went in a party, and found that the King was of the same opinion. We were told that he was endeavoring to wean his people from their national pastime, the bull fight. The King was accompanied by the Queen and the young princesses; and they seemed to enjoy the game. As the crowd passed the royal box, some simply stared, others doffed their hats, while the ladies courtsied. King Alfonso evidently is a democratic monarch, such as circumstances obviously require; he plays a difficult part with tact and dignity. The football itself was excellent; it was soccer, or association, which is a highly skillful game and delightful to watch. The opponents were an English team, the West Ham, and a picked number of Spanish players. The latter excelled in their individual play, but the team work of the English gave them the victory by a score of two goals to one. Where we sat we looked over a vernal landscape toward the snowy peaks of the Guadarrama range.

As to the success of the Congress, I cannot say much, as I spent most of my time at the picture galleries of the Prado and at other places where geology was not the chief topic of conversation. A paper on the Great Rift Valley and another on the Dynosaur beds of Lake Nyassa represented the extent of my participation. The Germans, so long restrained from breaking forth into print, are now in an orgy of publication, and this exuberant condition was reflected at Madrid, where a large proportion of the papers of the Geological Congress were in German, and most of the others in Spanish.

The sessions of the Congress came to an end with a reception at the Royal Palace. A party of us, including Mr. and Mrs. C. Will Wright, and Mr. and Mrs. J. O. Haselden, dined at the Ritz before the reception. The dinner was served on the terrace, overlooking the garden, under a sky of Maxfield Parrish blue, with a young moon, and to the accompaniment, not too insistent, of an excellent band. It was a memorable occasion. Subsequently we went to the Palace, where we found ourselves ushered by resplendent lackeys into a series of imposing chambers, where we were welcomed by the Prime Minister and the members of his Cabinet. We also had an opportunity of meeting, again, our own Ambassador, Mr. Odgen Hammond, and his charming wife. Upon entering the audience chamber those of us who were delegates sorted ourselves at the places where the name of our country was marked. The King and the Royal party, including the Queen, the Queen Mother, and the young Prince, made the circuit of the room, stopping in turn to speak to the visitors. The King was accompanied by Señor Rubio, the president of the Congress, and Señor De Lome, the secretary, and these gentlemen made the necessary introductions. I had the honor of a short conversation with the King and Queen successively; that with Her Majesty was amusing; Señor Rubio mentioned the fact that I came from California, whereupon the Queen remarked: "I hear that California is very beautiful."

"Almost as beautiful, Madam, as Andalusia."

"You are most polite."

"Yes, we have nearly the same flora, the shrubs and flowers are much the same."

"And you have Spanish names."

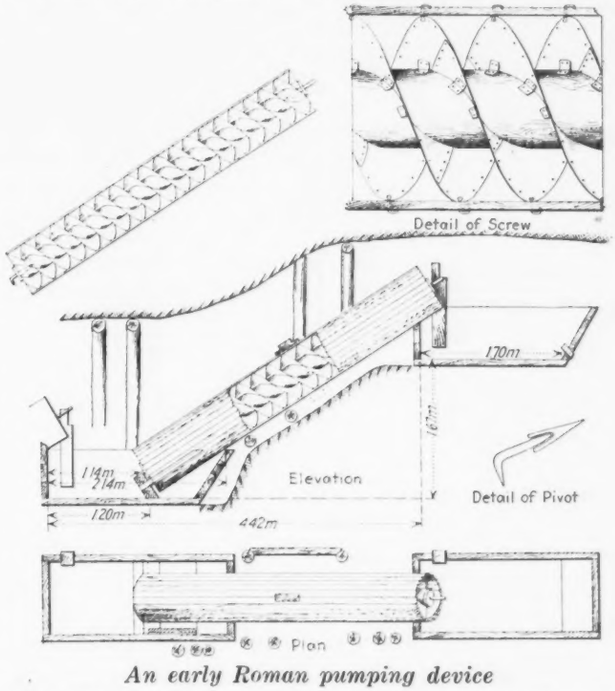
"Yes, Madam, but they are horribly mispronounced."

"Are they? How is Los Angeles pronounced?"

"Los Angeelees and Los Angaylays, and other variants, all wrong."

"Yes, that is wrong; the accent is on the first syllable; it should be Los Aanhaylez."

"Thank you, Madam, on my return to California I shall be glad to tell my people how the name of our southern city should be pronounced." The Queen smiled and passed on. My wife laughed and remarked that in speaking of "my people" I spoke like a potentate, but, after all, when you are talking to potentates, it is as well to talk like one! I have only to add that the Queen of Spain pronounces Los Angeles "Los Aanhaylez" (only the first syllable stressed), whereas I pronounce our southern city won-der-ful!



An early Roman pumping device

This machine, based on the principle of the Archimedean screw, was described in the first of Mr. Rickard's articles, p. 922 of the June 4 issue.

Properties Desired in Garnet for Abrasive Purposes

In Bulletin No. 677 of the Canadian Department of Mines, V. L. Eardley-Wilmot gives the qualifications of abrasive garnet as follows:

Many of the species of garnets vary considerably as to color, hardness, toughness, and method of fracture. For the best abrasive purposes the mineral must be the hardest possible, at least 7.5 (quartz is 7.0). When the garnet is crushed the grains should break into sharp angular fragments without curves or flat or rounded edges. The mineral should be so tough as not to break too easily and so brittle that the individual grains will eventually break and form new cutting edges rather than become rounded under the strain of use. When used as a coated abrasive long, "slivery" or thin grains do not arrange themselves correctly, as they tend to lie too flat, thus presenting a smooth surface, or they protrude above the surrounding grains and scratch. Furthermore, the crushed garnet grains should have a high capillary attraction so that glue will completely cover and adhere to them when they are being coated onto paper or cloth. Color does not seem to have any bearing on abrasive qualities, but the deep red-colored mineral is always preferred. This may be a prejudice from the fact that the Spanish garnet is of a pale pink color and is also of inferior quality.

The garnet should allow of being broken into comparatively large (pea size) clean and solid pieces with a minimum amount of fines, so that the full ranges of grades necessary for coated papers can be obtained; therefore, deposits that contain garnets of very small crystals are of little or no commercial value, no matter how great the garnet content of the rock may be. Granular garnet usually breaks into rounded grains; other deposits containing large crystals which are badly shattered would, with little pressure, crumble almost to a dust. The grains in garnet sand are not only too small but are also rounded by erosion and water action. Among the common types of deposits those containing clean unfractured individual red crystals, at least the size of a pea, but preferably larger, should be suitable for abrasive purposes and the ore should contain at least 10 per cent garnet to be commercially valuable. The solid, hard, and compact massive garnet might be used commercially, but comparatively little experimental work has been done on this type. Up to the present the highest-grade abrasive material has been obtained from the large laminated crystals or boulders of red garnet such as occur in New York State.

Almandite is by far the commonest of the garnets and is the type most employed for abrasive purposes, although andradite and rhodolite are also used. They are all iron garnets.

A Correction

In the tabular assay of flotation feeds and products in the communication of R. A. Pallanch on page 1054 in the June 25 issue of *E. & M. J.*, the zinc concentrate assay was given as 2.2 per cent. Mr. Pallanch had written 48.9 per cent. The table should have read as follows:

	Ounces Per Ton	Per Cent		
	Ag	Pb	Fe.	Zn
Feed	4.5	8.6	11.5	9.2
Lead concentrate	30.0	66.0	8.8	2.2
Zinc concentrate	2.0	3.2	8.6	48.9
Pyrite concentrate	0.6	0.8	43.8	0.9
Tailing	0.5	0.8	15.2	1.0

Precipitation of Gold and Silver from Cyanide Solution on Charcoal

A study designed to develop improvement in the cyanidation of gold and silver ores by means of precipitation of these precious metals from cyanide solution on charcoal has been made by the rare and precious metals experiment station of the U. S. Bureau of Mines, situated at Reno, Nev. The study was intended primarily to investigate the possibilities in practice and secondarily to investigate the mechanism of the precipitation itself.

That charcoal has the power to abstract gold and silver from cyanide solutions to the extent of 7 per cent of its weight in gold and 3 per cent of its weight in silver without showing the slightest change in appearance, even under the microscope, clothes it with a mystery that has long interested metallurgists. Even now, with the mass of data made available by various investigators, much remains to be learned. At present, charcoal adsorption is being studied by many persons, and their investigations may eventually lead to its application to a variety of purposes not indicated by such research as has so far been done.

During the investigation many ramifications were revealed, in following any one of which a lifetime could be spent. Charcoal, the chief factor, is subject to myriad variations due to differences in raw materials, preliminary treatment, and methods of charring. Added to the variations possible in the charcoal itself are those possible in solutions and in methods of precipitation. The results obtained in this investigation are summarized as follows:

The mechanism of the precipitation involves adsorption accompanied by a chemical change.

Precipitation of silver on charcoal from cyanide solution follows the same laws as precipitation of gold, although it is slower; charcoal has less capacity for silver than gold.

The limit of charcoal precipitation from cyanide seems to be about 2,000 oz. of gold and about 1,000 oz. of silver per ton of charcoal.

Little difference exists among charcoals prepared from different woods.

The most important point in the making of charcoal is the heat treatment, either during the making or subsequent thereto.

To quench charcoal does not improve it.

Pulverization finer than 200 mesh does not appreciably add to the efficiency of charcoal.

Few substances in the solution appreciably affect precipitation.

Adsorbed gold or silver salt is soluble to some degree in boiling water, and such a salt is especially soluble in hot cyanide.

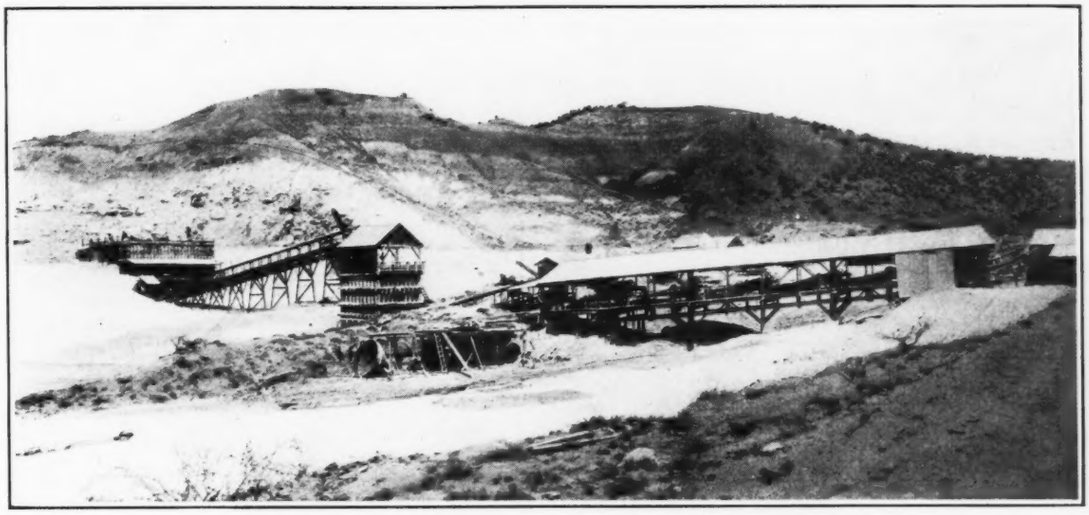
There is a possibility of so changing the adsorbed gold or silver salt on charcoal that the charcoal may be used for further precipitation.

Charcoal will precipitate gold or silver from a cyanide ore pulp; the charcoal can then be separated from the pulp by flotation.

Further details of this investigation are given in Bureau of Mines Technical Paper 378, "Precipitation of Gold and Silver from Cyanide Solution on Charcoal," copies of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 15c.

Mining Sodium Sulphate at Camp Verde, Arizona

By George J. Young
Associate Editor



General view of sodium sulphate deposit at Camp Verde, showing the quarry, receiving bin, and washery

SURFACE EXPOSURES of soluble salt deposits are comparatively rare, especially in the Western mining states. One of the most interesting is near Camp Verde, Ariz. Apparently the more or less irregular beds of thenardite (sodium sulphate) associated with some mirabilite (hydrated sodium sulphate), glauberite (anhydrous sulphate of lime and soda), and rock salt are in the Verde formation and have been exposed over a relatively small area by erosion. The Verde formation covers a wide extent east of Clarkdale and east of the Verde River generally, although a narrow area is also west of the river. O. P. Jenkins, who described this formation,[1] states that the greater part of the Verde formation is a cavernous limestone interbedded with sands, gravels, and clays; strata are generally horizontal and evenly bedded.

The sodium sulphate deposits, according to Jenkins, occur where the formation is thickest and represent the final evaporation of the concentrated brine that marked the last stages of a Tertiary lake. The deposit where quarried is covered with an overburden of varying thickness. Its extent is not known, and no special effort has been made to determine its limits by boring, as obviously there is enough sodium sulphate to meet the needs of the company for an indefinite time. Records of shafts and drill holes at different points upon the deposit are available and confirm the presence of large tonnages of the mineral.

A quarry has been opened out where the deposit is comparatively free from overburden, and a single bench is now being advanced. On the southerly end of the quarry a considerable amount of mirabilite is exposed in the face of the bench. At the opposite end massive thenardite in a comparatively thick bed is being quarried and sent to the washing plant. The quarry problem is complicated by the fact that as much as possible of the accessory salt and glauberite must be picked out. The rock salt is separated and dumped at one side of the quarry and is sold to cattle men.

Hand-held drills are used for primary holes and also for block-holing large pieces. The broken mineral is loaded into horse-drawn dump carts by a gasoline caterpillar-mounted power shovel and delivered to a receiving bin, over which is placed a grizzly that retains the large pieces. These are sledged down to grizzly size. The bin discharges to a Jeffrey crusher, which reduces the mineral to 1½-in. maximum size and discharges upon a belt conveyor, which in turn delivers to a storage bin. From this bin an automatic feeder delivers the mineral to a second belt conveyor leading to the log washers. These are in series, the first two consisting each of two log washers side by side; the remaining log washers following each other in tandem. The objective of washing is to dissolve as much of the salt as possible and to remove the clay, an accessory constituent. Under the agitation set up in the washers the clay is broken down and forms a suspension in the solutions. To avoid dissolving sodium sulphate, used solutions are introduced at the head of the log-washer series and pass from washer to washer, a countercurrent movement. The final solution, with its suspension of clay, is run into a pond, settled, and pumped back. It is planned to install a series of Callow cones for the removal of the clay and to waste the sludge and accompanying solution, replacing the solution volume lost by additions of fresh water.

The final washed mineral is delivered upon impact screens, which remove the surplus water and discharge upon a No. 3 belt conveyor. This in turn delivers to a cylindrical oil-fired drier, 8 ft. in diameter and 50 ft. long. The dried sodium sulphate is delivered to a bucket elevator and discharged upon an impact screen, which removes minus-¼-in. size and sends oversize to a set of rolls. Undersize is stored upon a dump. Crushed sodium sulphate is elevated by a No. 2 bucket elevator and sized and delivered by a series of screw conveyors

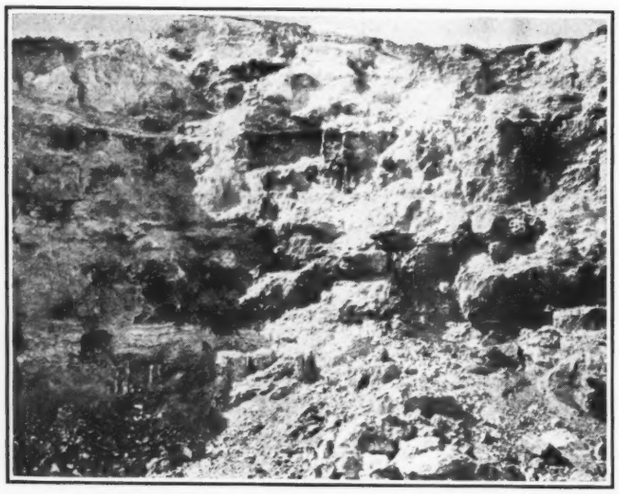
[1] *American Journal of Science*, Vol. 5, Jan., 1923.

to different bins. The trough of the conveyor is a punched plate screen, and it functions satisfactorily for sizing. Three sizes are made: coarse plus ½ in.; medium ¼ to ½ in.; and fine, minus-¼-in. mesh, from which the very fine has been separated by further screening. The product is marketed over a wide area. It is hauled by motor trucks to Clemenceau, from which point it is shipped.

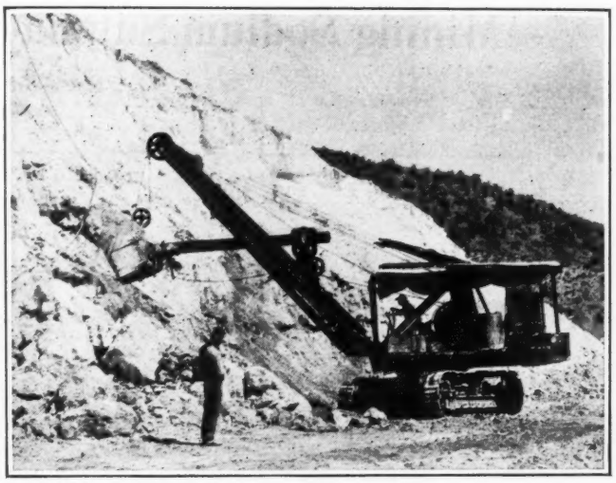
Crushers, log washers, drying furnace, and accessories are driven by electric motors, power for which is supplied by the Arizona Power Co. There are twenty motors in the plant, and the power requirement ranges from 190 to 202 hp. Forty men are employed, the output varying in quantity but averaging from two to three carloads per day, or from 90 to 135 tons. The sodium sulphate contains 95 per cent of sodium sulphate, insoluble 2; magnesium sulphate, 0.3; calcium sulphate, 1 plus, and chlorides from 1.2 to 2 per cent. The property is owned and operated by the Sodium Products Corporation, of Los Angeles. R. W. Coad is president and general manager, James Allen superintendent, and John Quinn assistant superintendent.

The largest consumers of sodium sulphate are the kraft pulp and paper manufacturers, whose requirements in the United States are estimated at 250,000 tons per annum. The glass industry uses about 75,000 tons per year and the manufacturers of stock remedies use about 50,000 tons. Stock-remedy manufacture centers in the Middle West. In addition medicinal purposes, dye, textile, and tanning industries consume comparatively small amounts.

An interesting feature of the present operations is the finding of prehistoric evidences of early mining, probably representing the first underground mining in Arizona. These consist of stone hammers and picks, sandals, brush torches, and some human remains in the form of bones. One skull has been found. Mr. Allen, with a smile, asked me if I wished to see the morgue, and upon my assenting took me to the transformer house and indicated several powder boxes containing bones and other relics of the old-time miners. He also showed me a number of stone hammers. One of these was complete, with a bent wooden handle. I hefted the implement and twirled it around. It balanced as well as its late cousin, the single jack. Both bones and tools came from a black woody layer intercalated in the sodium sulphate beds. Evidently this



South end of sodium sulphate quarry, showing mirabilite



Gasoline-operated power shovel used in working the sodium sulphate deposit

layer represented the position of the old underground workings long since caved and closed down tightly. From the evidence at hand it would appear that the prehistoric miners mined in upon the rock-salt exposures and placed a layer of brush upon the floor of their workings. Illumination was afforded by rude brush torches, several of which, in a partly burned condition, have been found. That mining accidents occurred, chiefly through falls of ground, is obvious from the human remains found in the brush layer marking the position of the workings. It is conjectured that the prehistoric miners were cliff dwellers, as were their forerunners, as remains of the cliff dwellings are to be found in the Verde Valley, notably at Montezuma's Castle, at Montezuma's Well, and in the vicinity of Clarkdale, on the Verde River.

Chuquicamata—A City in the Desert

According to a recent issue of *Chile*, the Chile Copper Co. has built 189 houses in Tocopilla to accommodate all of its workmen and employees in the "coast" district of Chile. The company's store also operates for the convenience of its employees, and the store is equipped with refrigerating plant, as well as an ice plant. Meat is brought in on the hoof, killed upon arrival, and kept in cold storage until needed.

In Chuquicamata the company has built and maintains a hospital with 128 beds, besides a special maternity hospital for 22 cases. There are five physicians and surgeons on the hospital staff, besides 98 nurses and other employees. The hospital buildings are all one-story structures, built on sanitary principles, and having a most up-to-date equipment throughout the operating rooms, wards, and private rooms. A central heating plant supplies steam and hot water throughout the entire hospital group.

The company has also built two schools for children of workmen, which can accommodate 1,700 children. These schools are steam heated and completely equipped throughout.

Fifteen years ago there was not a house where the settlement known as Chuquicamata now stands. Today there are about 18,000 men, women, and children living in Chuquicamata, practically all housed in buildings, of which 3,560 have been constructed by the company.

Useful Operating Ideas

Standardized Drill Round at New Market, Tenn.

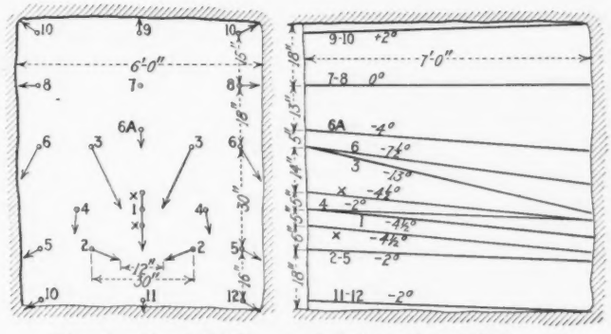
By F. L. Ballew* and W. H. Boyle†

When development work was first started at the New Market (Tenn.) property of the Grasselli Chemical Co., the question arose as to how much footage could be made in a 6 by 7-ft. drift by using the best drill round. The country rock is almost pure dolomite, which is very hard in places and in other places is much brecciated and contains recrystallized dolomite. Ordinarily, it is a fast drilling rock. At the start a progress of 7 ft. per round was considered about as much as could be made. By using standard cuts and by drilling under contract it was found difficult to make this footage, so that considerable attention was given to some other round which would break a greater footage. A cut was finally devised by the mine foreman, F. L. Ballew, which enabled him to break any round to almost any depth, and a description of this round is given with the idea that it may be found useful in other mines.

The accompanying illustration will show that the round differs from other drill rounds only in respect to the cut. So far as we know this cut is unusual and should be applicable to any kind of rock. The cut consists of seven holes, the holes 1 and *X*, *X*, being known as "burn-out" holes. The holes *X*, *X* are drilled parallel to and about 5 in. from Hole 1. Hole 1 is filled with explosive without tamping, and is fired. The charge of powder breaks the rock between 1 and *X*, *X* and leaves a hole which extends clear to the back of the round. Holes 2, 2, 3, 3 can then break to this hole and with a large pyramidal opening to any desired depth; there is no difficulty in breaking the entire round to the bottom of the drill holes. One of the advantages of the cut is that holes 2 and 3 do not have to be drilled at the steep angles required in the ordinary 4-hole cut, nor do they have to be close enough at the bottom to blast all four holes simultaneously. Any one who has ever tried to make footage in a small prospecting drift will appreciate this feature.

It is not unusual for contractors to break 10 ft. at a round. The only difficulty is in placing the explosive so that it will break to the bottom and at the same time not leave the collars of the holes unbroken. Filling the hole with explosive is one solution, but the contractor who buys his own powder does not favor the idea. At present, we use 30 per cent explosive, which distributes the effect so that the footage can be broken with the minimum powder cost. By using this burn-out cut we are driving 4- by 4-ft. raises at the rate of 6 ft. per round. Owing to the presence of seams of calcite, it sometimes happens that blasting Hole 1 will cause one or more of holes 2 and 3 to "weld" at the bottom, and to prevent this these holes are filled with water while the "burn-out" is being fired. All holes are fired by fuse. In hard ground the water may be omitted and the whole round detonated at once, but in brecciated ground the round is fired in three stages, the usual procedure being as follows:

1. Blow out "burn-out" holes, 1 and *X*, *X*, and fill holes 2, 3, and 4 with water.
2. Fill Hole 1 loosely with explosive, tamping last stick only, and fire.
3. Blow out holes 2 and 3, load and fire, selecting the hole with the lightest burden to go first.



Standardized drill round using the Ballew cut

4. Blow out remaining holes and fire them in the order given in the figure.

The sketch shows a drill round for a depth of 7 ft. This was made from a round as drilled and the round broke over 7 ft. The round does not need to be drilled exactly as shown so long as the four cut holes are placed so that they will break to the "burn-out." In some ground it may be necessary to vary the distance between Hole I and "burn-out" holes *X*, *X*, although 5 in. has always been satisfactory.

By using two No. 7 Waugh drifters on columns, two miners and a helper drill and blast the round in less than eight hours, mucking being done on the night shift. At times, more faces are being worked than our limited hoisting facilities will handle, and it is necessary to take all drill steel longer than 8 ft. away from the contractors so that footage is held down to about 7½ ft. per round. With longer steel so much muck is broken that it is a problem to get it moved away from the face in one shift.

Although the principle of the "burn-out" is not new, we believe that its application to a drill cut is somewhat different from the usual rounds described, and we shall be interested in learning of its results in other camps.

*Mine Foreman; †Superintendent, the Grasselli Chemical Co., New Market, Tenn.

Final Clean-Up of Milling Plant

The details in the final clean-up of the milling plant of the Langlaagte Estate & Gold Mining Co. were given by J. Davidson in a recent number of the *Journal of the Chemical, Metallurgical and Mining Society of South Africa*, as follows: Total tonnage handled in the plant was slightly more than 12,000,000 tons. The first step taken in 1922 was to prospect thoroughly the various accumulations lying outside the plant, to determine as far as possible their nature and value. These differed

considerably, some of the heaps having their origin in excavations for extensions to plant and some from around pile blocks; others, however, were composed principally of waste, grease, screening, camsticks, and almost any old rubbish. Outside the cyanide extractor house the deposits were found to contain ashes, sweepings, bricks, lead prills, and even parts of bars as well as other refractory material, showing that a pan furnace had at one time been in use. Outside the assay office the accumulations from samples and other sources were found to be rich enough to warrant the expense of treatment.

The policy adopted was to start with the cleanest and richest deposits. A sluice was erected near the mill. It consisted of three launders, in series, each 14 ft. long by 14¼ in. wide, and having a fall of 1½ in. per foot. At the head of the first launder a distributing box was fixed. This also served as a screen to eliminate coarse material and waste. The first launder was fixed with riffles made in sections of 3 ft. Its bars were inclined at 45 deg. and set 3 in. apart. The other two sections of the sluice were fitted with corduroy. Each of these sluices had a capacity of from four to five tons per day. A good supply of clean water is necessary for good results.

Only the slimy portion of the pulp (and of that only a small percentage) was run to waste. The fine sand and grit were settled in pits and conveyed to the mill circuit, where, after fine grinding, the cyanide extraction was satisfactory. Combustible material and the coarse lumps were accumulated in heaps and thoroughly burned preparatory to further treatment for the recovery of such values as were contained.

During the first three years, 7,000 oz. of gold was accounted for by this method, at a cost of about 8s. per oz. After the plant was officially closed down, a few stamps were reserved for crushing coarse material and grit. So long as the feed was fairly clean, fine screening was used and the tailing was cyanided. The supply of this material was limited, so it became a matter of finding out the most suitable product for the best concentration results.

A concentrating table was added to the outfit, and was a useful adjunct in preparing concentrates for treatment at the smelting works. The concentrates carried from 24 to 40 oz. gold. The usual method of treatment for refractory material—that is, sintering and smelting, was adopted. Thus a high recovery of values was made.

In 1925 the sluicing operations were extended considerably, and to increase the recovery an alteration was made in the sluices. The second and third launders were doubled, the pulp stream was divided, and extra water supplied. This improved the extraction, bringing it up to 66.70 per cent, which was considered fairly satisfactory.

The old vanner floor had evidently been well cleaned up, but the old tail races, pump sumps, and launders yielded quite a good return. Though mercury seems to penetrate to quite a considerable depth around pile blocks, it carries comparatively little gold with it. The total recovery of mercury that was made was over 20,000 oz.

In the cyanide section a few surprises were in store. The launder leading from the sand collectors to the slime plant, although regularly cleaned out up to a short time before closing down, carried a lime scale which was found to be very rich. The launder was 450 yd. long, and yielded 1,943 oz. It is difficult to explain why it should have absorbed so much gold, as the grade of slime flowing through it was not high. Some years ago when two plants at Randfontein were being dismantled it was found that although they were similar in design and operation the lime scale on one set of slime launders was extremely rich, though on the other it was practically barren.

The steel extractor boxes, some of which had been in use for more than twenty-five years, were scaled after being put out of commission. The return was good, so they were painted first with salammoniac and afterward with strong hydrochloric acid, and allowed to stand for a fortnight, when they were again scaled. Results were so encouraging that the process was carried on for twelve months. The total recovery from this source was 1,450 oz. from twenty-three boxes. The absorption of gold in the steel is not easily accounted for, as the returns from the treatment of similar boxes in other mines vary greatly. In contrast to the boxes the scale obtained from the "steady heads" assayed only 2 dwt.

Quite a fair return was obtained from pan furnace ashes, sweepings, and bricks. The reverberatory pot furnace, when dismantled, gave a return of only 10 oz. The result of the work, extending over a period from 1922 to 1927, was the recovery of 22,405 oz. of gold at a cost of £21,083.

How to Install Cylinder-Head Gaskets on Gasoline Engines

Cylinder-head gaskets in a heavy-duty type of engine require more attention than those used in an automobile engine. When installing a new gasket, the operator should proceed as follows:

(1) Clean all surfaces. (2) Place the gasket on the head with the dark side down and shift it on the studs until all water openings index properly. (3) Put on the head and draw the stud nuts down, beginning with the nuts in the center portion of the head until all are just bearing on the head. (4) Tighten the nuts gradually, working back and forth across, not around, the head, always keeping more tension on the nuts in the center portion of the head. Continue until all nuts are drawn tight. (5) Run the engine without load until thoroughly warmed up. Stop and go over all nuts again, beginning with the nuts in the center portion of the head. (6) Tighten the nuts frequently and persistently for three or four days until the gasket is finally compressed and it is impossible to turn the nuts any further.

The procedure just described should be followed for a new engine going into service for the first time. When heads are removed for grinding valves it is well to install a new gasket, although frequently the old gasket can be successfully used again if not damaged and if carefully installed.

Operators who follow these simple rules will avoid engine trouble which might cause delay and a consequent loss in profits and production time to the engine power. These recommendations are those drawn up by the engineers of the Climax Engineering Co., Clinton, Iowa.

News of the Week

Summary

REPRESENTATIVES OF INDUSTRIES interested in an expansion of the economic work of the Bureau of Mines are to appear before Director Lord of the Bureau of the Budget.

A round-up of high-graders in Timmins, Ontario, a few days ago is believed to have resulted in the capture of one of the best organized gangs in the district. One member is said to have disposed of over $125,000 worth of gold within the last two years.

Carnegie Institution of Washington, D. C., sends two scientists to the upper peninsula of Michigan to do exploration work involving electrical prospecting.

Developments at Lorrain Trout Lake Mines, in South Lorrain, Ontario, continue encouraging and indications point to the property returning to its former status.

Team using a Chicago Pneumatic drill wins the annual drilling contest held at Miami, Okla., on July 2.

Panama Corporation issues synopsis of engineer's report stating that encouraging results have been obtained and suggesting a separate company be formed to operate the Remance mine.

Over 250 mines and quarries in thirty states participate in the 1926 National Safety Competition. In the underground metal mining group the Muncie zinc and lead mine, operated by the Federal Mining & Smelting Co. at Baxter Springs, Kan., was adjudged the winner.

Mohawk mine, in the Michigan copper district, produces over 11,000,000 lb. of refined copper during the first six months of the year.

New 150-ton lead concentrator of the Copper Queen branch of the Phelps Dodge Corporation near Warren, Ariz., is put into operation.

Russo-Asiatic Consolidated, Ltd., undertakes the development of the Mount Isa deposits.

Mining Nitrate with Electric Shovels in Chile

Anglo-Chilean Consolidated Nitrate Corporation's Plant Largely Electrified—Movable Trolley Line on Waste Dump

ELECTRIC SHOVELS are to be used in the nitrate region of Chile for stripping overburden and for mining nitrate-bearing rock. This will be done by the Anglo-Chilean Consolidated Nitrate Corporation, which is now building an electric power plant at Coya Norte. This plant is to be located at the mines on the pampa, about 5,000 ft. above sea level and 40 miles inland.

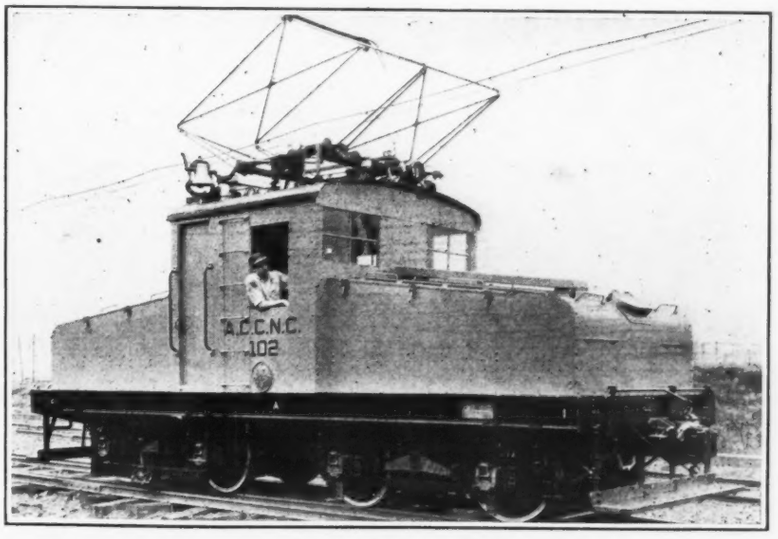
One of the first steps will be the partial electrification of the railroad running from the seaport, Tocopilla, to the mine. This is now a steam road and is owned by the corporation. It was constructed about forty years ago, is very crooked and follows the contours of the mountains. Fresh water for the steam locomotives is obtained by distilling sea water. The boilers are fired by fuel oil.

The present plans call for electrification of the heavy grade section of the railway only. Power will be secured from the plant located at the mines and will be transmitted by a three-phase, 60-cycle transmission line at 33,000 volts. There will be two automatic railway substations, each containing two 750-kw. synchronous motor generators and automatic switchboard control for converting the 33,000-volt power to 1,500 volts direct current.

Existing rolling stock is being brought up to date by the installation of automatic couplers and air brakes. Trains will be handled initially with 60-ton (metric) locomotives. These will be arranged for multiple-unit operation, and later, as traffic increases, trains will be double headed. The locomotives will be provided with regenerative braking for controlling the speed of descending trains without using the air brakes. With steam operation the item of brake shoe and tire wear is considerable. The locomotives will receive power from an overhead copper trolley wire supported by means of catenary construction of standard type.

The two railway substations will be fully automatic and directly under the control of the train dispatcher by means of a supervisory control system. It is the intention to dispatch the ascending and descending trains in such a manner that full advantage of regenerative power will be obtained. Good economies are expected through reductions in brake shoe and tire wear and the saving in power.

As the ore is mined it will be handled by six full revolving shovels. Each shovel will have a dipper capacity of 3 cu.yd. and will be driven by a motor



Type of electric locomotive used by the Anglo-Chilean Consolidated Nitrate Corporation at Coya Norte, Chile

generator consisting of a 190-hp. motor and three generators having a total output of 150 kw. to the three main motors on each shovel. Alternating current supplied to the driving motor of the motor generators will be changed by them to direct current to operate the shovel motors.

The ore will be loaded by the shovels into trains pulled by electric locomotives. There will be thirteen 30-ton combination trolley and storage battery type locomotives for this purpose, one of which is to be equipped with side-arm trolley for use at a later date, and all of which will have both pantograph and third-rail shoes. These locomotives will be used on 500-volt trolley and 190-volt battery service, 42-in. gage track. The majority of the locomotives will be used in hauling the ore from the workings to the mill where it is treated. Others will haul the waste to the dumping loop.

The tracks to and from the workings will be permanent and arranged for trolley service. Operations will be handled in a loop, there being a number of crossovers through the mine proper to the return side of the loop. These crossovers, occurring at intervals, will have temporary tracks, as they will be constantly shifted as the shovels move along into the bank. It is over this temporary track that the locomotives will operate on the storage batteries.

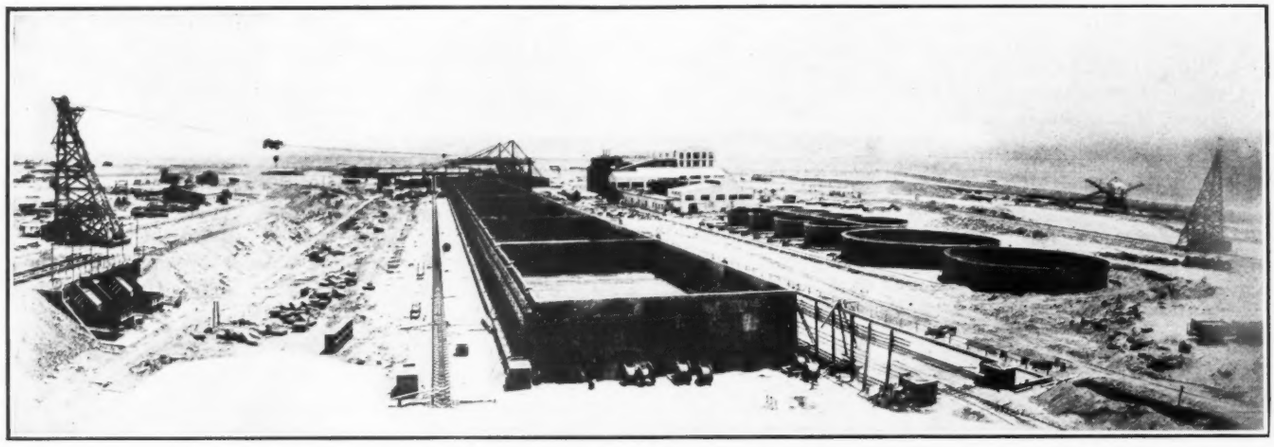
On part of the waste dump loop track a special type of pole will be used, enabling the pole and line to be moved easily as the dumping face is extended. Each pole will be attached to a section of track and, as the line is to be moved, the track sections and poles will be moved at the same time, thus keeping the trolley always above the center of the track.

Where the waste dump trucks run beside the leaching vats it would be impossible to use any form of trolley construction, and this part of the track, for a distance of 1,600 ft., will therefore be provided with third rail. The rail will be of special construction and well shielded to protect it against the dripping salt solution. An automatic sectionalizing switch will connect the third rail to the trolley.

When the voltage of the system falls below a certain predetermined value, the voltage will be boosted and power factor improved automatically by means of a synchronous condenser.

Rail bonds will be welded with a portable arc welder consisting of a 4-cylinder, 22½-hp. gas engine driving a 200-amp., 25-volt generator.

Practically all of the electrical equipment for the project is being furnished by the International General Electric Co., including the locomotives, transmission, substations, electrical equipment on the shovels, and the majority of the industrial motors. Power will be generated by Diesel engine-driven generators, the generators and switchboard being of European make.



Panorama of the plant of the Anglo-Chilean Consolidated Nitrate Corporation at Coya Norte, Chile. Leaching vats are seen in the foreground with the unloading bridge at the far end. To the right of the unloading bridge are the power plant and crystallizing plant; in the extreme right is the finished-product tower

Some of the electric shovels used by the Anglo-Chilean Consolidated Nitrate Corporation at Coya Norte, Chile

Much Activity Reported in Several Ontario Districts

Michael Syndicate Discovers Sulphide Orebody—Goudreau Contracts for Diamond Drilling

There is much activity in the Goudreau mining area, Algoma district, northern Ontario. The Michael Syndicate, Ltd., which optioned the property of the Dominion Goudreau Syndicate, lying in the eastern part of the Goudreau area, just south of the Cline property, has made an important find. The Dominion Goudreau was previously counted as a gold property, and all work done was in reference to finding that metal. During this work a small showing of copper ore was exposed, but little work was done, as the gold values were small. This showing has now been opened up by the Michael Syndicate, and quite an extensive body of massive sulphides has been exposed. These sulphides are made up of pyrrhotite, chalcopyrite, zinc blende, and pyrite, the two economic minerals of the group being copper and zinc. This find is regarded as most important, and may change the whole complexion of the Goudreau area.

On the property of the Farquhar Mines, Ltd., a vein from 4 to 12 ft. in width has been trenched and stripped over a length of 1,500 ft. A preliminary sampling of part of this vein gave encouraging gold assays, and a thorough sampling of the entire vein is now being carried out by the company.

The Goudreau Gold Mines have contracted for 3,000 ft. of diamond drilling to explore at depth the veins recently exposed on the surface. A considerable amount of work is being carried on by the Detroit Syndicate, which optioned the Michael properties north of Pine Lake last year.

Exploration of the various properties in the mining area of northern Ontario known as Woman and Narrow lakes is going ahead rapidly. It has been estimated that between 500 and 600 men are engaged in exploratory work in the area and numerous new finds are being steadily made. It is the opinion of some engineers that Woman Lake will become one of the largest gold

camps on the continent. Values being secured in various parts of the country average quite high.

It is reported that important interests have made a deal on a large group of claims at Pipestone Bay. Ontario Woman Lake is reported as negotiating with two groups for holdings it has in the camp. These involve the first claims staked in the camp on the west shore of Woman Lake. Recently a new and important vein of white quartz was found on this group. It carries high values over a good width. There are several other veins on this property on which a lot of work was done, including 10,000 ft. of trenching and the sinking of twenty-five to thirty test pits.

Following interesting discoveries made in the last couple of weeks there is considerable activity in the staking of mining claims in a new area of the Patricia district of northwestern Ontario. The scene of the new staking is 12 miles southeast of Woman Lake and about 40 miles east of Red Lake on the shores of an unnamed lake, at the head of the Uchi River, a tributary of the Wenasaga River. Since the rush the lake has been called Long Lake by some and Fissure Lake by others. Gold occurring in quartz veins is reported, as well as narrow veins of chalcopyrite carrying gold. Effective use of the airplane has been made in getting into the new prospecting area.

Work is being rapidly pushed on the Howey property. This is the pioneer discovery of the Red Lake district. When the property was relinquished by the Dome company some time ago the district received a slight setback, but it is now promising to make a bid for a place among the producing fields of the province. The shaft on the Howey is now down over 60 ft. and gangs are now working on three eight-hour shifts. Ore from the shaft, which is being sunk to 500 ft., is of higher grade than was indicated by diamond drilling, and the enterprise is becoming of even greater importance than was at first supposed, according to reports from the property.

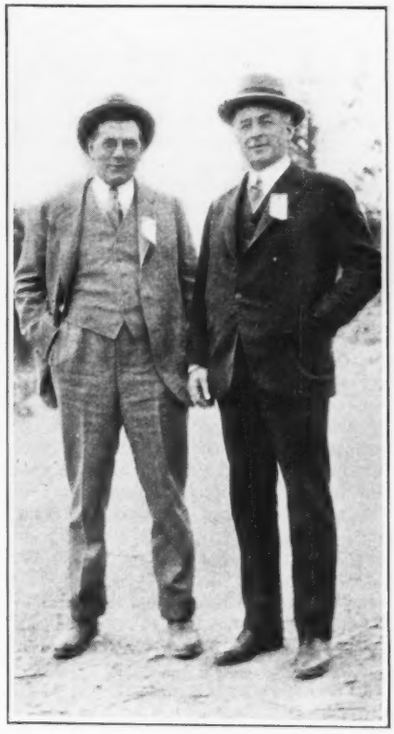
Reports of the discovery of a promising gold field about 25 miles north of Armstrong, Ontario, are being made, and there is already quite a rush to the new camp. News of the new gold rush was brought to Timmins by J. Ray O'Neill, former member of the federal government, who staked some fifteen claims in the vicinity of the new find for a syndicate composed of Ottawa and Montreal men. A certain amount of copper was also found. The mineralized zone on which the staking was done is said to be over a mile wide and from four to five miles long. The formation is diabase and granite, and the condition is said to be much the same as in the Porcupine camp.

One of the most promising features of the mining situation in Ontario in 1926 was the extraordinary activity in prospecting. Not fewer than 13,496 mining claims were staked in the province during the year. This is the largest number since the busy year of 1907, when the silver boom was at its height. About half of the claims were staked in the Patricia district, although there was considerable staking for gold in the district of Thunder Bay and Michipicoten, and other eastern divisions.

Boards of Trade Visit Mine and Smelter

Delegations in British Columbia Learn of Importance of Mining Industry to the Dominion

S. G. Blaylock, general manager for the Consolidated Mining & Smelting Co. of Canada, in speaking to sixty-five delegates from the Associated Boards of Trade of eastern British Columbia, who recently visited the Trail smelter, used some readily assimilable and interesting figures in describing the operations at Trail. He said that the smelter now was able to produce 760 tons of metals per day. The lead department has a daily capacity of 410 tons of refined metal, which approximately is 10 per cent of the world's output; the zinc plant 280 tons, also approximately 10 per cent of the world's output; and the copper department 70 tons of refined metal. The company used roughly 5,000 tons of structural steel, 3,500,000 bricks, and 6,500,000 ft. b.m. of lumber annually; it used a car of cement every two days. It consumed annually 118,000 tons of coal and 62,000 tons of coke. Its freight bill amounted to $3,600,000 yearly, which was 1 per cent of that of the whole dominion. It pays out $8,000,000 annually in wages, which is approximately $1,000 per hour; this, with supplies, makes the cost of operating the plant $3,000 per hour. The plant depends chiefly on the Sullivan mine for its supply of ores. Toward the end of last year two turbo-steam generators, having a total output of 4,000 hp., were installed at the Sullivan mine at a cost of $30,000 —they paid for themselves in ten days, and now their capacity is to be increased. Dale L. Pitt, general manager for the Premier Gold Mining Co., spoke in a somewhat similar vein to a delegation from the Vancouver Board of Trade that visited the Premier mine. He told the delegates that his company spent $50,000 monthly in Vancouver for supplies. During the last seven years it had created approximately $26,000,000 of new wealth, has spent $5,000,000 in supplies, and has paid out $4,500,000 in wages. The mine has produced more than 24 tons of gold and 645 tons of silver. The capitalization of the company is $5,000,000 and shareholders have already received nearly $11,000,000 in dividends. Nearly $1,500,000 has been paid to steamship companies for freighting ore and concentrate. During the last year the mine produced 4 tons of gold, or 7 per cent of the gold output of Canada, and 100 tons of silver, or 14 per cent of the silver output of the Dominion.



S. G. Blaylock (left), with Hon. William Sloan, Minister of Mines for British Columbia

The above figures indicated to the Boards of Trade the importance of the mining industry to the country. Mr. Pitt's figures were impressive, but he was a little unfortunate in making his anouncement concerning Premier at about the time that Mr. Blaylock gave the data on Consolidated M. & S.

California Mining Notes

Apart from the operations of the North Star, Empire, and Idaho-Maryland mines, the Grass Valley district records several new movements. The Normandie mine, at Deadman's Flat, is to be operated again and exploration resumed. Negotiations for equipment and contracts are believed to indicate the preparations to sink a 500-ft. shaft on the Woods tract. Reports are current that sufficient finances have been obtained, or are in sight, to reopen the Allison Ranch mine. The company holding the mine was recently reincorporated as the South Grass Valley Mines. Western Merger Mines, at Blue Tent, is exploring its ground. Murchie mine, east of Nevada City, has been sold by C. F. Humphrey to J. M. Hoff and then transferred to the American Foundation. Preliminary work is in progress. Operations are also in progress at Gracie mines, on Canada Hill.

At Forrest Hill the Four Aces Co. is reported to have reached the producing stage. A five-stamp battery and ball mill have been added to the equipment. At Paradise, Butte County, the Blue Hog mine, on the Magalia Channel, is being operated; at French Gulch, Shasta County, the Accident group of nineteen mining claims owned by the Shasta Hills Mining Co. was sold under sheriff's sale to satisfy unpaid bills. The Columbus mine, at Cherokee, Tuolumne County, has been taken over under a working lease by W. E. Ernst from the Cherokee Mines Consolidated, and preliminary work toward resuming operations is under way.

Contracts have been signed by the Pacific Coast Borax Co. with the Southern Sierra Power Corporation to extend a power-transmission line to Rich Station to provide power for its operations north of Muroc, Kern County, where two shafts have been sunk into the borax beds, which are from 200 to 300 ft. below the surface.

Mining Industry Stages Big Safety Contest

Bureau of Mines Announces Winners—More Than 250 Mines and Quarries Participate in 1926

Winners of the National Safety Competition, in which more than 250 mines and quarries in 30 states participated in 1926, have been announced by the U. S. Bureau of Mines. The winning mines and quarries in this nation-wide industrial safety contest, held annually under the auspices of the Bureau, are presented with the bronze trophy "Sentinels of Safety," donated by the *Explosives Engineer*.

Notable accomplishments in the production of large mineral tonnages with no loss of time occasioned by accidents were revealed by the detailed statistical reports furnished the Bureau by the competing companies. A zinc and lead mine in Kansas operated 300 days and worked 206,489 man-hours without an accident involving loss of an employee's time. A Missouri zinc mine and 14 large quarries, located in West Virginia, Pennsylvania, Alabama, Indiana, Ohio, Kansas, California, Virginia, and Michigan, also operated through the year with no loss of time as resulting through personal injuries. The competition was one of the largest industrial safety contests ever held, and involved the tabulation of all accidents occurring during the course of 95,000,000 man-hours of labor. It required the preparation of accident statistical reports on a uniform, detailed basis, which allows a more exhaustive study of the causes of accidents than has heretofore been possible.

Secretary Hoover, in addressing congratulatory letters to the winning mines and quarries, emphasized the importance of the American mining industry attaining world leadership in accident prevention as it has already attained such leadership in the production of mineral tonnages.

The more than 250 mines and quarries participating in the competition were divided into five groups: Anthracite mines, bituminous coal mines, metal mines, mines producing non-metallic minerals, and quarries, or open-pit mines. A replica of the trophy is awarded to the mining operation in each group sustaining the smallest loss of time from accidents in proportion to total time worked during the year. Determination of the winners was made by a jury of award comprised of officials of various mining and quarrying associations, the National Safety Council, and the American Federation of Labor, based on a tabulation of mine accident data prepared by the Bureau of Mines. A feature of the competition is the awarding of a certificate of honor, signed by the Director of the Bureau of Mines, to every employee of each of the winning mines and quarries for his share in the low-accident records made by their companies.

In the underground metal-mining group, the Muncie zinc and lead mine, operated by the Federal Mining & Smelting Co., at Baxter Springs, Cherokee County, Kans., was adjudged the winner. Honorable mention was accorded the Velten zinc mine of the Eagle-Picher Lead Co., at Pierce City, Mo.; the Wilbur zinc and lead mine of the Commerce Mining & Royalty Co., at Treece, Kan.; the Armour No. 2 iron mine of the Inland Steel Co., at Crosby, Minn.; and the Lucky Bill lead and zinc mine of the Federal Mining & Smelting Co., at Cardin, Okla.

In the group of underground mines producing non-metallic minerals, the trophy was awarded to the Grand Rapids gypsum mine of the Beaver Products Co., at Grand Rapids, Mich.

In the quarry and open-pit mine group, the trophy was awarded to the No. 5 and 6 limestone quarry of the North American Cement Corporation, at Martinsburg, W. Va.

West Colusa Mine Crew Has Good Safety Record

An enviable safety record has been established by the West Colusa mine crew of the Anaconda Copper Mining Co. at Butte, Mont. This crew, shown in the photograph below, worked a total of 4,768 man-shifts during the first five months of 1927 without a lost-time accident. Harry E. Callison is assistant foreman; Charles White, shift boss; and W. D. Griffith, safety engineer at the property.

Crew at the West Colusa mine of the Anaconda Copper Mining Co., Butte, Mont.

Several New Strikes Reported in Arizona Districts

High-Grade Orebody Discovered in Tom Reed Mine, at Oatman—Another on the McGinnel Property

A new high-grade orebody, 10 ft. wide, has been discovered in the Aztec workings of the Tom Reed mine, at Oatman, Ariz. A winze had been sunk from the 500 level to the 700 in ore of milling grade when the mine was under lease to Jack Shank. On the 700 level a drift was carried 150 ft. to the east, where the values pinched out and work was stopped. The company started the drift again a short time ago, and almost immediately struck high-grade ore, which occurs 160 ft. east of the winze and 165 ft. west of the east end line of the United American property. The ore at present has to be trammed to the foot of the winze, hoisted 200 ft. to the 500 level, and trammed 500 ft. to the main shaft of the United American property, where it is hoisted to the surface, and then sent by truck to the mill over a mile away. The management expects to connect the 700 level workings of the Aztec with the 900 level workings of the American, these having the same elevation. This will improve ventilation and cut down the tramming. The Tom Reed mill is at present handling 75 tons of ore daily from the Aztec and Ben Harrison mines.

The Superior district, which has already furnished three mines—the Silver King, the Magma Copper Co., and the Belmont Copper Co.—may add another producer to its list. A strike uncovering high grade values in a 5-ft. ledge has been made on the property of the McGinnell Copper Mining Co. A contact of ledges, opened in a 190-ft. crosscut from the main working shaft, is reported to enclose a 3-ft. vein of rich ore. The ore is at a vertical depth of 500 ft. Work on the ledge will be started at once, and it is thought that the first carload will be ready for shipment to the Magma smelter about the middle of this month. Officials of the company expect to be soon shipping a carload a day from the property.

Operation of the new 150-ton lead concentrator of the Copper Queen branch of the Phelps Dodge Corporation near Warren has been started on a sixteen-hour schedule. Later on operation will be increased to twenty-four hours. At present, only ore furnished by the local properties of the Phelps Dodge Corporation and the Shattuck Denn Mining Corporation is being treated at the mill, but lead ore from numerous other producing companies and properties will be treated there soon. Construction of the concentrator was started last fall.

Officials of the Western Apex Co. are making arrangements to start milling their ore. This will probably be done at the Tom Reed or one of the other two mills in the district. The Western Apex has an orebody 1,275 ft. long and 8 ft. wide on the 700 level. Drifting on the same orebody on the 850 level is in progress.

At the Katherine mine the mill capacity has been increased to 300 tons per day. Installation of the electric pumps has been completed in the new

shaft station on the 900 level, and crosscutting to the vein on this level is to start at once.

Operations on the property of the Dover Copper Mining Co., west of Morenci, in the Clifton-Morenci mining district, are reported to include the building of a road from the mine to the Morenci-Eagle highway, which will be used to truck ore to the railroad for shipment to the Clifton smelter, instead of packing it on burros, as has been done in the past. Tunnel No. 1 is reported to have been driven into the mountain a distance of 600 ft. on the vein. The shaft has been sunk to a depth of 375 ft. During the last twelve months $30,000 worth of ore, mined in development work, has been shipped to the smelter.

The Sonora Development Co. at Congress has installed a new dragline scraper and a new screening and washing plant. A 200-ton concentrator is about completed. The company owns a large tonnage of dump ore said to average $9 per ton in gold. The ore is to be delivered to the washing plant by the dragline scraper, and, after being screened and washed, will be elevated to the mill, where it will be crushed and ground in preparation for flotation treatment.

The Sloan Andrews asbestos mine, in the Sierra Ancha Mountains, near Roosevelt Dam, has resumed operations after having been idle since the days of the war. A group of Hollywood capitalists has taken over the property, and expects to employ about fifty men. William Andrews, of Globe, is superintendent.

A well-defined ledge of copper ore is reported to have been located in the northern side of Tempe Butte, which rises above the main street of Tempe, about 9 miles east of Phoenix. The ledge is said to be traceable across the river, with an overhanging contact of hard, red sandstone, in a granitic country rock. The deposit is being worked by W. A. Goodwin, under special authority from the city council.

The Comstock Silver and Bevis Divide companies have called a meeting of stockholders to arrange for further financing, in order to prosecute additional development work and increase treatment facilities. The present mill of the Comstock Silver, which is now being operated at 70 tons, will be stepped up to 100 tons.

A station has been cut on the 900 level of the Katherine Gold property. Crosscutting to the vein, 300 ft. away, will begin the first of next month. The mill is now treating 285 tons of ore daily from the 100, 200, and 300 levels, and good mill values are being reported. As a result of ten days' output at the mill, 152 lb. of bullion was sent to the mint recently.

Goldenville Mines Ships Gold From Two Properties

Three bricks of gold valued at $3,000 each were sent to Halifax from Goldenville, Nova Scotia, early in June. They represented a three weeks' clean-up from the Goldenville mines in Guysboro County. The Goldenville company controls the Goldenville and Cochran Hill properties.

News From Washington

By PAUL WOOTON
Special Correspondent

Non-Metallics Receive Consideration

Representatives of Industries Interested in Economic Work of the Bureau of Mines to Appear Before Director Lord

A PLAN is being formulated for the appearance before Director Lord of the Bureau of the Budget of prominent representatives of the industries interested in an expansion of the economic work of the Bureau of Mines. Consideration now is being given the presentation of arguments to show the need for additional services for the nonmetallics; for better information on the distribution and consumption of petroleum products; complete and periodic statistics of the coke and coal products industries; quarterly coal stock surveys, and a resumption of the reports on distribution from producing to consuming districts formerly made by the U. S. Geological Survey.

The cement, lime, clay, sulphur, stone, gypsum, magnesite, and fertilizer material industries have annual production worth more than a billion dollars. It is felt that this group is entitled to those services which the government performs for many other industries of the country.

The services which the petroleum industry would like to see the government perform are the gathering of information as to stocks held at points other than refineries; the movement of refined products from refineries to points of consumption; and marketing and transportation methods and information as to consumption divided according to uses and districts.

With respect to coal it seems unlikely that any new work will be urged until the present disturbances are settled, but it is thought that the services already begun should be speeded up and strengthened.

A reduction in the freight rates on pigs of foundry iron from Virginia producing points to Baltimore, Philadelphia, New York, and Boston has been ordered by the Interstate Commerce Commission. The existing rates to those points are $4.41, $5.17, $5.54, and $5.92 respectively. The new rates prescribed are: Baltimore, $3.88; Philadelphia, $4.54; New York, $4.87; and Boston, $5.21.

The Virginia producers pointed out that many of their furnaces are not in operation and contended that this was owing to excessive freight rates and to preferential rates from mines in Pennsylvania.

The carriers contended that the condition of the Virginia producers is typical of the industry as a whole and that Pennsylvania furnaces also are closed down. This was ascribed to foreign competition rather than the level of freight rates.

Joplin-Miami District Holds Annual Drilling Contest

Mine Produced 132,676 Tons of Lead and 823,603 Tons of Zinc Concentrates in 1926

Frank Cox and James McCarroll, representing the New York mine of the Cortez-King Brand Mines Corporation, won the annual drilling contest held at the Imaim Amohalko celebration at Miami, Okla., on July 2. This team, using a Chicago Pneumatic drill, set up the machine, drilled through a 6-ft. concrete block, and took down the drill again in 2 min. 39 sec., beating the record established a year ago by 6⅔ sec. O. Harper and J. Newman, representing the No. 1 mine of the Lawyers' Mining Co., won second place. They used an Ingersoll drill and required 2 min. 47⅔ sec., although this included a 5-sec. penalty for failure to get their hose back into the box properly. J. Flynn and A. Garner, representing the Robinson mine of the Kansas Explorations Co., using a Chicago drill, won third place. They required 2 min. 52⅓ sec. The first prize was $100 in gold, the second $50, and the third $25.

Ground has been broken at Bartlesville, Okla., for the new $500,000 acid plant of the National Zinc Co. It is expected that the first roasting unit of the plant will be ready for operation by Nov. 1 and the second about a month later, and that the plant will be completed before the one at Argentine, Kan., is closed. The Bartlesville plant will be the largest in the United States, and will produce 180 tons of sulphuric acid daily, which will be shipped by tank cars to refineries in Texas, Arkansas, Kansas, and Oklahoma. The contact method will be used in producing the acid. L. W. Leverett is superintendent of the plant.

A total of 16,677,100 tons of ore was handled by the mines of the Joplin-Miami district in 1926, according to figures compiled by J. P. Dunlop, of the U. S. Bureau of Mines, and just made public. From this tonnage was recovered 132,676 tons of lead and 823,603 tons of zinc concentrates. The Oklahoma section of the district handled most of the tonnage, the total from this state being 10,934,000, or approximately two-thirds of the whole. Kansas properties accounted for 4,717,500 tons, leaving only 1,025,500 tons for Missouri mines.

Conditions at the middle of 1927 indicate there will be a sharp reduction in production for the year.

Oregon Production Decreases

The U. S. Bureau of Mines reports that mineral production in Oregon in 1926 was valued at $334,740, a decrease of $96,013 compared with 1925. Production of gold and silver decreased, whereas that of copper and lead increased.

London Letter

By W. A. Doman
Special Correspondent

Panama Corporation Issues Brief of Engineer's Report—Mount Isa Under New Control

London, June 28—Since I last wrote concerning the Panama Corporation, V. F. Stanley Low, the corporation's engineer, has made his report to the directors. This is now under consideration. Meanwhile, a synopsis has been issued, which states: (1) That prospecting and exploration are being carried out on sound lines; (2) that encouraging results have been obtained; (3) that the progress made has been good; (4) that in view of the rapid development that has taken place at the Remance mine, early consideration should be given to the advisability of forming a Remance development company to operate this portion of the Veraguas concession; (5) that only a very small part of the extensive concessions has yet been prospected, and that it will take at least three years to complete the first prospecting campaign; (6) that results already obtained warrant an increased expenditure on improving lines of communication, in extending mule tracks, in improving cart roads, and providing mining requirements. Such expenditure will be necessary if further work is to be carried on expeditiously and economically. The extent of the concessions and the systematic work which is to be undertaken are indicated in the synopsis.

I have before set forth my conclusion that the last had not been heard of the Mount Isa mines, after their being turned down by the Anglo-American Corporation's engineers. The business has now been undertaken by the Russo-Asiatic Consolidated, which will provide the capital required for development. The Russo-Asiatic has purchased from Mount Isa 550,000 £1 shares at par, which carry an option on 200,000 further shares at £2 per share. Opinions differ as to whether the property will turn out to be another Barrier Range, but the major part of comment is in that direction. Ore in sight is said to equal several million tons.

Minerals Separation, Ltd., has issued its annual report showing a credit balance of £26,688, and is paying a dividend of 10 per cent. The company has been actively engaged in testing a process at coal mines. In this country results have proved disappointing, but on the Continent there is a considerable improvement over the previous year. The tonnage of coal treated has increased and new plants have been brought into operation.

The metals production plant installed by the Bwana M'Kubwa Copper Co. is operating satisfactorily, and the Union Minière is expected to start up the first unit of the large-scale plant next month.

Tin is again over £300 per ton, and the public is once more taking an interest in the market. Things are not quite so active as they would otherwise be, owing to the social events which attract not only the public but also members of the stock exchange. Last year the Keffi Consolidated Tin (Nigeria) produced 1,170 tons of tin concentrates, and increased its proved reserves from 8,344 tons to 12,653 tons. This represents a gross value of over £2,500,000, and yet 80 per cent of the company's holdings remain to be developed.

The Ashanti Goldfields (West Africa) announces that a reef cut at the No. 21 level (supposed to be the old and rich Cote d'Or) is 34 ft. 9 in. wide, and assays 2 oz. 6 dwt. per ton. At the No. 22 level, where it was first struck, it was 56½ ft. wide, and assayed 30.9 dwt. per ton.

Southern Rhodesia Base Metals Corporation, which is regarded as having exceptionally bright prospects, has experienced the lot that falls to most mining undertakings in the early stages—delays. Transport difficulties are the trouble on this occasion; the company's program, however, is expected to be completed by the end of the present year. P. K. Horner is again on his way to the property, and R. M. Johnson, who was at one time superintendent at the Union Minière and later with Anaconda, is now acting as manager. The power plant is in operation at the Copper Queen mine, and another power plant is in course of erection at the Copper King mine.

The mining companies of the Witwatersrand are now declaring their half-yearly dividends. Twelve maintain the previous interim rate, twelve are slightly higher, and six announce reductions. It is interesting to note that of the last named five are deep-level properties. Either the gold content of the ore at depth is lower, or working costs at depth have not been reduced in the proportion that was anticipated. A good deal of capital has been made out of the use of the jackhammer drill. It is economical and is being generally adopted. A statement in a weekly journal commenting upon these machines strikes a rather disturbing note, for it says that they will require more man-power, as the effective life of the workers would be limited to about twelve months. Possibly some of the mining companies may take up the matter.

The fiftieth annual dinner of the Royal School of Mines was held in London on June 17, under the auspices of the Old Students' Association. Professor W. H. Merrett, president of the association, in his address, stated:

"Tonight we are celebrating our fiftieth annual dinner; the first one actually took place in 1873, as these pleasant functions were suspended for four years of the war period. During the time which has elapsed since our first dinner some 1,200 students have graduated at the Royal School of Mines, while about 800 others have taken special courses, making a grand total of approximately 2,000 R.S.M. men who have passed through our co'lege in the normal fifty years. This period does not, however, represent our full age; officially we were born in 1851, although a department of metallurgical chemistry had previously been in existence for about six years. From the writings of our indefatigable honorary secretary, Professor Truscott, I cull the words that 'We were born in 1851 of the Geological Survey—Sir Henry de la Beche and the Prince Consort being our sponsor and patron respectively. We were called into being as a part of the plan to develop the mineral riches of this country and its then colonies on scientific lines. Our early development was essentially geological, the prominent officers of the Survey being our first professors, while we were housed with the Survey at the museum of practical geology.' Our official age is seventy-six, and, in spite of our years, we are still flourishing.

"Before concluding, I would like to say a few words about our R.S.M. Old Students' Association. This dinner tonight is a School of Mines function which was in operation for forty years before the association was formed. Our association was initiated only in July, 1913, and the movement emanated from a speech made at the fortieth annual dinner by Mr. T. A. Rickard, so that he is really its founder. The objects of the association are: (1) To foster the comradeship, to advance the interests, and to present the views of R.S.M. men. (2) To assist any of its members in whatever manner may be deemed possible, and generally to continue the objects of the R.S.M. Old Students' dinner committee."

Alaska School of Mines Offers Five-Year Course

Beginning next September the Alaska Agricultural College and School of Mines will offer both a four- and a five-year mining course. The four-year course follows the more or less standardized curriculum of study common to other mining schools, and leads to a bachelor of science degree in one of three options — mining engineering, metallurgy, or geology and mining.

The fifth year is designed for graduates of the four-year course, particularly those who have had one or more years of practical contact with the mining industry, and who appreciate the fact that the present era of industrial development has created an increasing demand for the type of engineer whose highly specialized technical skill is broadened by basic training in the principles and practice of modern business methods.

Dean Ernest N. Patty has planned this fifth year as an answer to the prevalent criticism that the present curriculum of our engineering schools has too strong a tendency to mold narrow technicians. A few schools have met this problem by requiring one or two years of liberal-arts study as a prerequisite to the engineering course. Dean Patty feels that the average high-school graduate who elects engineering is generally impatient to plunge into his engineering studies. After four years of technical study he is more mature and has a better perspective of his chosen profession; hence he is better prepared to get a full measure of value from courses such as economic problems, business law, sociology, and related studies.

About half of the fifth year at the Alaska College will be devoted to work in business administration; the remainder will be given to advanced study in mining, metallurgy, or geology.

Arcadian Consolidated Develops No. 8 Conglomerate Vein

Calumet & Hecla Extends Operations—Mohawk's Production Higher and Costs Lower Than Last Year

Conglomerate vein No. 8 has been tapped by a crosscut driven east from the 1,250 level of the New Baltic shaft of Arcadian Consolidated, and found to be well charged with copper. Two cuts have been taken out, revealing highly mineralized vein rock. The crosscut will be continued through the vein, after which drifts will be started in both directions and a thorough exploration made of the development. No. 8 conglomerate is one of the master lodes of the Michigan copper district, and it is of interest generally in mining and geological circles to learn that the vein is mineralized, contrary to the old belief that it did not carry copper. This lode also was exposed by a crosscut driven from the 900 level of the Arcadian shaft and was found to be mineralized at that point, which is 3,500 ft. distant from the New Baltic shaft. To have disclosed values in the conglomerate at these two widely separated points is considered significant by the Arcadian management. The vein, where exposed by the crosscut from the Arcadian shaft, was found to be 40 ft. in width. Development work also recently encountered the old Arcadian lode in a crosscut west from the 1,250 level of the New Baltic shaft. The vein is 16 ft. wide in the crosscut, with fine copper in evidence throughout. This formation will be opened later by drifts in both directions on the strike.

Calumet & Hecla Consolidated will extend its operations on the Osceola lode by reopening No. 16 shaft, which has been undergoing repairs for several months. The shaft will soon be ready for operations, upon completion of the new railroad connections. No. 17 may resume later in the year if men are available. This program would leave only No. 18 idle. The lode is richer to the north than to the south, particularly in Nos. 17 and 18 shafts. A fair grade of ground, however, is coming from three shafts on this formation. A vigorous program of shaft sinking and drifting is in progress. Two shafts that were in use all last year and a third in operation the latter half of the year produced more than 9,000,000 lb. of refined copper. Many men from the Seneca mine, now closed, will most probably be given employment in No. 16 shaft. The haulage tunnel in the 80 level of the conglomerate department is in successful operation from No. 7 Hecla shaft. Copper rock below this level, more than 8,000 ft. from surface, is hoisted by an electric hoist installed in the 80 and transported by electric locomotives to the Red Jacket shaft for hoisting to surface. Thirty-six 7-ton tram cars which dump automatically are available for this work. Stoping or mining is proceeding in the 81, 82, and 83 levels, north and south, in No. 7, and drifting is under way north and south down to the 91, north to the Tamarack boundary and south to No. 12, Hecla. No. 7 will be stripped of pillars, arches, and backs of stopes above the haulage tunnel; this work is already under way. It is estimated it will require fifteen to twenty years to remove the available ground, which is rich in copper. The decision to mine out No. 7 will necessitate using No. 12 as a man-shaft as well as a supply unit.

Production from the Mohawk mine the first six months of the year was the best in the history of the property. It was well over 11,000,000 lb. of refined copper, 2,000,000 lb. more than the output for the same period in 1926. Costs are below those of last year, which was a good year for Mohawk both in respect to production and costs.

Manganese Producers to Hold Meeting

A MEETING of American producers of manganese ores will be held at the Willard Hotel, Pennsylvania Ave. and 14th St., Washington, D. C., at 10 o'clock Tuesday morning, August 2, 1927.

The purpose of this meeting is to organize and consolidate efforts in behalf of American manganese. Questions of importance to the United States so far as manganese is concerned, and questions of importance to manganese ore producers will be discussed. All persons directly interested in American manganese ores are advised to attend this meeting, or to communicate promptly with one of the members of the following named committee:

J. Carson Adkerson, Woodstock, Va.
N. H. Mannakee, Bluefield, W. Va.
H. A. Pumpelly, Oswego, N. Y.
J. H. Cole, Philipsburg, Mont.
Wm. D. Meyering, City Hall, Chicago.

Carnegie Institution to Send Scientists to Michigan

In the copper and iron research work in the upper peninsula of Michigan, for which the Michigan College of Mining and Technology at Houghton has received from the state legislature an annual appropriation of $50,000 for the next two years, arrangements have been made for the co-operation of many agencies, such as the Michigan Geological Survey, the U. S. Bureau of Mines, the U. S. Coast and Geodetic Survey, the Carnegie Institution, of Washington, D. C., and the mining companies of the copper and iron districts of Michigan. The work is being organized along well-defined lines, each phase of which will be given equal attention.

Leading up to exploratory investigations, designed to locate new orebodies, special work will be done in co-operation with Michigan College of Mining and Technology by two representatives of the Carnegie Institution, of Washington, Messrs. Stroham and Rooney, of the department of terrestrial magnetism. They will start their work in August. It will involve delicate tests of electric currents found near the earth's surface, using new scientific methods developed by the institution.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Development Work Encouraging at Lorrain Trout Lake Property —Shipments Resumed

Toronto, July 8—Developments at the Lorrain Trout Lake Mines, in South Lorrain, continue to be encouraging, and all indications point to the property staging a real come-back. In a small winze below the bottom level the main vein shows an average of 6 to 9 in. of excellent ore, which is in addition to two other high-grade veins recently found. At present the company is taking just sufficient ore from this cut to complete a carload and following this the main winze will be continued deeper. This will be the first shipment of ore from the new south shaft of the Lorrain Trout Lake and will be the first shipment from the property in many months.

At the annual meeting of the Keeley Silver Mines, of South Lorrain, the managing director stated that though ore reserves are in a healthy condition, the amount of high-grade ore is considerably less than a year ago, and it is therefore considered advisable to reduce the monthly production, so as to conserve the reserves while development of the orebodies in the western part of the mine is in progress. These orebodies have been developed to the 895 level, where some high-grade with milling ore has been found. It is also stated that, with the lower price of silver and the reduced production, the dividend will necessarily be cut. The company is not yet in a position to make a definite announcement as to the production which it expects to maintain. For the last few years output has been at the rate of 125,000 oz. a month.

A round-up of high-graders in Timmins a few days ago is believed to have resulted in the capture of one of the best-organized gangs in this district. Nine persons were arrested, and it is understood that gold to the value of more than $25,000 has been recovered. The first arrests were of a man and women who were boarding a train for Montreal. They were found to be carrying several thousand dollars of gold in specially constructed vests. Following this seven persons in Porcupine were rounded up and a considerable amount of gold was recovered. Among these seven was one man, a farmer, who is believed to be one of the biggest high-graders in the district and who is said to have disposed of more than $125,000 worth of gold within the last two years. High-grading is a serious menace to the mines of Porcupine, and the amounts stolen are of large proportions.

Goldfield-Beatty Railway Line May Be Abandoned

The Bull Frog & Goldfield Railway Co. has applied to the Interstate Commerce Commission for authority to abandon its line from Goldfield to Beatty, Nev. The line is 79 miles long and is being operated at a loss.

Situation at the Mines

Marked Curtailment in Zinc Production Continues—Reduction in Copper Output Grows—Operations of Lead Producers Begin to Reflect Low Market Prices

By H. D. Keiser
Assistant Editor

CONTINUED LOW PRICES of the non-ferrous metals during June resulted in a noticeable increase in the curtailment of operations at the mines. This was especially evident in the zinc mining districts, where little hope is held for any marked change in existing conditions prior to early fall. The low copper market is apparently of growing influence, several producers having either shut down or reduced their operating forces. In the lead mining industry the larger operators are curtailing to a limited extent, and the uncertainty regarding the future has had the effect of discouraging new mining operations.

Copper

A total of 10,074,000 lb. of refined copper was shipped by boat out of the Michigan district in June. Shipments by rail have not been as brisk of late as in the last two or three months, but the average for the year is well up to that of the first half of 1926. However, production still is considerably under normal of pre-war years. Output of refined metal in 1926 was 175,000,000 lb., the largest since 1919, when production was 178,000,000. Average, or "normal," output for a number of years before the World War was 220,000,000 lb. Further curtailment in the Michigan district would prove somewhat disastrous, inasmuch as mine labor is difficult to assemble and reorganize. Since restriction of immigration, mine labor is scarce and, with the competition offered by the automotive and other industries, hard to keep together.

An additional curtailment of production is evident on the part of the Arizona producers. Inspiration Consolidated, which recently passed its quarterly dividend, has just redlced its operating force by 400 men, most of whom were in the concentrator and underground departments. The condition of the copper market was the reason given for the action.

In Canada, the new shaft of the International Nickel Co. at its Frood mine is down more than 1,000 ft. It is now apparent that the proposed program of expansion of this company, including the new plant for the treatment of the high-copper orebodies of the Frood, will involve an expenditure of about $12,000,000.

Lead and Zinc

Further curtailment of production occurred in the Joplin-Miami district during June; the number of operating mills fell below a hundred, and the weekly production of concentrates decreased to below 11,000 tons. Little improvement in present conditions is anticipated during the remainder of the summer, but increased activity is expected early in the fall.

The continued low prices of lead and zinc, and uncertainty regarding the future, have discouraged new mining enterprises in the Coeur d'Alene district, Idaho. Production, however, has been affected to only a limited degree. Some of the large producers have curtailed lead production to some extent, but in the aggregate production in June was little below normal. Construction of the electrolytic zinc plant at Kellogg by the Sullivan Mining Co. (Bunker Hill and Hecla) is progressing according to schedule, and it is expected that the plant will be ready for operation by the last of the year. This will result in immediate increase of zinc production, which is now practically limited to the output of the Morning mine. Zinc production at the Sidney mine is being stored awaiting completion of the zinc plant. The most notable event of the month was the purchase of 325,000 shares of treasury stock of the Douglas Mining Co. by Bunker Hill & Sullivan at 25c. per share, the proceeds to be used in further development of the mine. The Douglas property is on Pine Creek and has been quite an important producer of zinc and lead. Development plans now being carried out are expected to place the mine in condition for steady production, the zinc output of which will go to the Sullivan electrolytic plant and the lead to the Bunker Hill smelter, which is maintaining operations at the usual capacity, two of its four furnaces being in service.

Lead-Silver

The first evidence of curtailment among the Arizona operators occurred on July 1, when the Shattuck Denn lead concentrator at Bisbee was closed for an indefinite period as a result of the marked reduction in the price of lead. Preparations have been started for an extensive development campaign on the Hiltano lead-silver claims in Pima County, which have recently been acquired by the Calumet & Arizona Mining Co. The old Gunsight mine, near Ajo, which formerly was a big producer of silver-lead ore, is being cleaned up and put into condition for steady operation. Sufficient ore to warrant building a mill has been developed.

During June there was no material curtailment at the Utah mines. However, it is stated that because of the current low metal prices, Utah Copper will close for six days during July, that during the summer Utah Apex will work only two Sundays a month, and that Utah Delaware will eliminate all Sunday work.

Gold and Silver

Installation of a hoist and concentrator are under way at the Vulture mine, in the Wickenberg district of Arizona; mine operations at present consist of work above the 600 level and in the old workings. At Midas, Nev., the Gold Circle Consolidated recently was the cause of the renewal of bullion production in the Gold Circle district following a dormant period of five years. Considerable interest exists at present in the Divide mining district, about five miles from Tonopah, where leasers on the property of the Brougher Divide Mining Co. are developing a promising surface showing. Conditions in the Tonopah district remain unchanged, with the estimated bullion production of the district for June placed at approximately that of the preceding month.

At Weepah, Nev., the population has gradually declined until at present it is estimated there are about 500 people in the district. The original high-grade strike has so far proved to be no more than a small pocket, although further development may show it to be more important.

In Canada the annual reports of the silver companies show lower earnings as a result of the low silver prices. Both Nipissing and Keely have cut their dividends, and Canadian Lorrain has been closed. Gold production continues to increase, and in May the output from Kirkland was greater than that of any other month in the camp's history.

Iron

The Lake fleet moved 8,458,925 tons of iron ore from the mines of the Lake Superior district during June, a decrease of 311,626 tons from the June movement of last year. Shipments for the season to July 1 were 17,771,482 tons, an increase of 2,877,683 tons over the same period of 1926. Most of the mines of the district are active, but there is no great rush of ore to the docks. Labor is plentiful on all of the ranges. An important change was made in the management of two of the largest operators on the first of July. M. M. Duncan resigned as general manager of the mining department of the Cleveland-Cliffs Iron Co., and S. R. Elliott, general superintendent, was named for the place. George R. Jackson, superintendent of the mines in the Negaunee district for the company, was appointed to the position of general superintendent. The mines in the Gwinn district are soon to close, and W. W. Graff, superintendent there, will go to the Negaunee post. W. A. Rose, assistant general manager for Pickands, Mather & Co., has been transferred from Duluth to the Cleveland office of the company. A. D. Chisholm, superintendent on the Gogebic range, has been appointed assistant general manager in charge of the mines in Michigan and Wisconsin, and F. P. Bostford, superintendent on the Mesabi range, has been named as assistant general manager for Minnesota. The Cleveland-Cliffs Iron Co. will at an early date abandon the Stephenson and Gwinn mines, at Gwinn, and the Republic, at Republic. The last-named property is one of the oldest on the ranges, having first been opened in the seventies.

Societies, Addresses, and Reports

Famous Engineering Museum at Munich

Shows Industrial and Technical Development Thoroughly and Interestingly for Engineer, Industrialist, Factory-Worker and the Public

By Edward J. Mehren
Vice-President, McGraw-Hill Publishing Co., Inc.

Munich, June 2, 1927.

THERE ARE NOW in the United States three projects for technical museums: one for Washington; one for New York, under the Henry R. Towne bequest; and one for Chicago, which Julius Rosenwald has offered to finance. Such proposals in the United States are not new, the Towne project having originated before the war. But the schemes have lagged. If, however, our engineers, manufacturers, teachers, and public officials could see the famous Deutsches Museum of national science and technology, at Munich, the projects would go forward with speed. Probably the Chicago project will advance rapidly, for the South Park Commissioners were here recently as Mr. Rosenwald's guests to study and report on the museum.

This is the third time I have seen this institution: in 1920 in the old building, in 1924 when the exhibits were being moved to the new structure, and now when the installation in the new quarters is complete. Each time the marvel grows; each time one wants to linger longer, to learn, to be inspired.

Extent of Exhibit

Try to imagine a single widespread building in which, in models and full-sized operating equipment, one can see and study the machinery, processes, methods, and structures of the major branches of engineering and the engineering industries—civil, mechanical, electrical, mining, and chemical. That is what the Deutsches Museum contains. Then, as a good engineer should, let one ask that there be added a demonstration of the theory and apparatus of the fundamental sciences — mathematics, physics, chemistry, geology, and astronomy. One will not be disappointed. These sciences, too, are well demonstrated and their laws explained.

For good measure, there are added thorough exhibits of ship development, of the airplane and the airship, of paper making, printing, textile manufacturing, and farming.

Adequate description of the scope of the museum is impossible in short space. The guidebook alone contains 360 pages of closely printed matter, the exhibits number 40,000 items, the floor space (exclusive of large items displayed in the garden) is 430,000 sq.ft., and the length of the route through the exhibits is just 10 miles.

The Planetaria

The two planetaria are among the most interesting features of the whole museum. One shows on a reduced scale the actual paths of the planets against a diagram of the zodiac. The other shows the planets and their movements as they appear from the earth. This is accomplished in a darkened room by projecting the heavens on a hemispherical ceiling. Both installations were designed and built by the well-known optical firm of Carl Zeiss, of Jena.

The mechanical planetarium shows the planets in their proportionate sizes, the sun, at the center of the system, being an electric light. The planets, at properly proportioned distances, travel in their respective paths and at speeds properly proportioned to one another.

Projecting the Stars and the Planets

Even more fascinating is the second planetarium. In fact, this type of planetarium has taken hold so strongly in Germany that seven additional installations have been made, in as many leading German cities, under municipal auspices, as part of the educational work in natural science, ranking with public maintenance of museums and botanical and zoological gardens.

Against a hemispherical ceiling are projected the fixed stars; they rise above the horizon and pass across the meridian just as they do on a clear night. Then the planets appear, as the lecturer proceeds with his explanation. The sun rises in its proper position for the day of the lecture. Evidently one cannot wait in the planetarium for twenty-four hours, to see the phenomena of the natural day; therefore the progress of the heavens is speeded up from a twenty-four-hour gait to a complete revolution in four minutes.

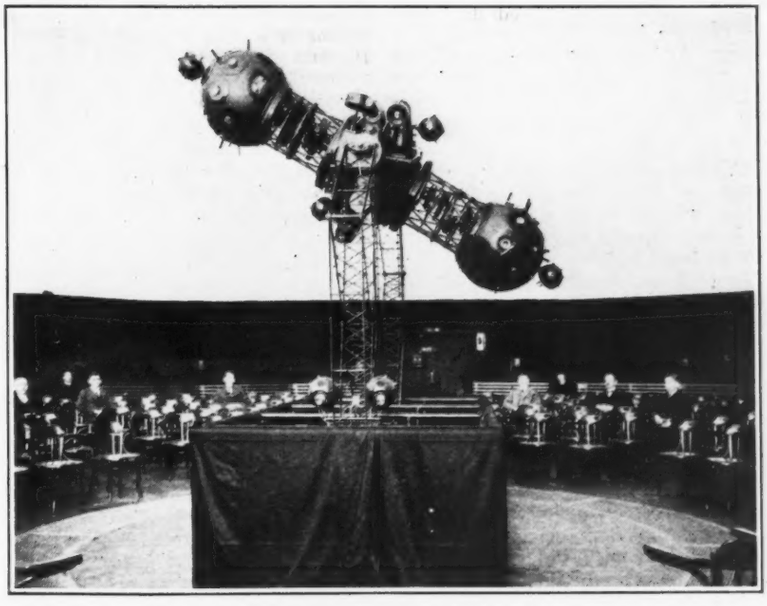
Then, to study the motions of the planets, the diurnal rotation of the heavens is stopped; in other words, we proceed on the assumption that the earth is now not turning on its axis. Then the motion of the planets is speeded up to a complete traverse of the heavens by the sun in four minutes. Through this speeding up the relation of the orbits of the planets to one another and to the sun is made clear.

Since the Munich projector was built a newer machine has been built and installed in the municipal museums. With these machines the whole heavens (of the two hemispheres) can be shown. One can be taken on a meridional journey over the North Pole, down the other side of the earth, crossing the South Pole, and returning to the point of beginning. At each latitude, northern and southern, the planets run their courses so that one can see where they appear at any time of the year, be he at the North Pole or the South, the equator or anywhere in between.

Further, the precession of the equinoxes is provided for in both machines, and one can see how the heavens will appear, from a given place on the earth, 1,000 or 5,000 or 10,000 years from now. The North Pole, be it remembered, shifts in the heavens over a long period, thus changing the position from which we see the fixed stars.

Conclusion

In closing this brief description, it should be added that the Deutsches Museum, like so many other great undertakings, owes its origin and development to one man. Many have helped. German industry has been lavish in gifts of full-sized operating machinery, models, and even building materials for the new structure. But the genius and painstaking direction behind it all have been those of Dr. Oskar von Miller, of Munich. He has built a monument to himself, and an example for similar efforts throughout the world.



Device for projecting the heavens. This intricate planetarium has been installed in seven large German cities

Personal Notes

H. W. Turner is testing a gold placer area in Montana.

R. W. Brigstocke is in England for a visit of about six weeks.

J. H. Curle, mine valuer and traveler, has returned to Johannesburg from Rhodesia.

M. W. von Bernewitz has been studying the unloading of ore boats and the loading of coal boats at Ashtabula, Ohio.

Edmund Jussen, mining engineer of San Francisco, and **George Steiner** have taken an agency for the Eötvös torsion balance.

P. M. Anderson, chief consulting engineer of the Union Corporation (South Africa), with Mrs. Anderson, has left Johannesburg for England.

Horace F. Strong, consulting mining engineer, has moved his headquarters from Haileybury, Ont., to room 909, 263 St. James St., Montreal, Que.

J. D. Sears, of the Geologic Branch of the U. S. Geological Survey, has gone to southeastern Montana to begin field work in the Tongue River coal district.

R. M. Santmyers, mineral specialist of the U. S. Bureau of Mines, is now upon a trip through Western states examining gypsum and barytes deposits.

President De Golyer and **Secretary Bain** of the Institute will be in San Francisco Aug. 12 and 13, and will meet with the members of the San Francisco section.

Fred B. Ely, geologist, has left New York for a three months' trip to Venezuela for the purpose of making geologic studies in the northern coastal country.

Milnerton Ford, manager of the T. G. M. E. Central Mines at Pilgrims' Rest, Transvaal, with Mrs. Ford, has left South Africa on a six months' holiday overseas.

George A. Packard, mining engineer of Boston, has just returned from the Red Lake district in Ontario. He estimates that there are more than 600 men in the area.

Roy Lewis, formerly joint managing director of the Vereeniging Estates, Ltd., has left South Africa for England, with Mrs. Lewis, to take up permanent residence near London.

Alford Roos, mining engineer of Vanadium, N. M., is spending two weeks in the Magdalena mining district of that state, examining property for Chicago principals.

H. C. Herbert will return to London from Chuquicamata, Chile, in September. His address will be care of John Gibbs Son & Smith, 11 Copthall Court, London, E.C.2, England.

John Daniell, consulting engineer, of Los Angeles, has been elected president of the Great Bend Mining Co., which is operating at Goldfield, Nev., and at Oatman and White Hills, Ariz.

Donald C. Barton has severed his connection with the Geophysical Research Corporation and opened an office as consulting geologist and geophysicist at Room 717 Petroleum Building, Houston, Tex.

Frank Leverett, of the Geologic Branch of the U. S. Geological Survey, is studying the older glacial drifts and associated deposits in New Jersey and Pennsylvania, in co-operation with the state surveys.

L. W. Mays, of Salt Lake City, has purchased *The Salt Lake Mining Review* and will be president and general manager. **L. E. Camomile** will remain as editor and the editorial and business staff will remain unchanged.

Henry M. Dougherty, chief engineer of the Chile Copper Co. in Chile, who has just completed a $20,000,000 extention to the company's plants in that country, is spending a vacation of six months in the United States. He expects to remain in New York for a few weeks and then to visit various parts of the country with Mrs. Dougherty, probably returning to Chile by way of the West coast.

Photo by B. Pinchot

Henry M. Dougherty

W. C. Alden, of the Geologic Branch of the U. S. Geological Survey, has left Washington for Ashton, Idaho, to resume studies of the glacial geology and physiography of adjacent parts of Idaho, Montana, and Wyoming.

Bernard W. Holman, of the Royal School of Mines, London, has been selected by the Institution of Mining and Metallurgy to attend the Empire Mining and Metallurgical Congress in Canada this summer.

W. T. Thom, Jr., of the Geologic Branch of the U. S. Geological Survey, has been transferred to the conservation branch for the purpose of mapping the Teapot dome. **E. M. Spieker** will assist Mr. Thom in this work.

Dr. A. L. du Toit, geologist to the Department of Irrigation, Union of South Africa, has resigned his post, to take up one more remunerative as consulting geologist to De Beers Consolidated Mines, in Kimberley.

Sir Edmund Davis has been knighted in recognition of his services in helping to develop the mineral resources of the British Empire. He is a director of numerous mining companies in Rhodesia, West Africa, and India.

Howard M. Ernst, of New York City, has been named to succeed the late J. A. Schloss as president of the Missouri-Kansas Zinc Corporation, an organization recently formed to operate several properties in the Tri-State district.

J. B. Mawdsley, of the Canadian Geological Survey, will explore an unknown area southwest from Chibougamau Lake, Quebec, which is underlain by Keewatin and other formations favorable for the occurrence of mineral deposits.

Miles Walker was recently appointed resident engineer by the Clericy Mines, Ltd., in charge of its eight properties in Dufresnoy and Clericy townships, in northern Quebec. Mr. Walker has had a wide experience in the mining fields of Africa and Asia.

O. McCraney, who was for a long time superintendent of the Shawmut mine, has accepted the position of superintendent of the Argonaut Mining Co. at Jackson, Calif. **H. J. Sheafe**, who has been superintendent for the last four years, has resigned.

Dr. Samuel Evans, chairman of Crown Mines, Ltd. (South Africa), accompanied by his wife and daughter, has left Johannesburg for England. They will attend the Mining and Metallurgical Congress in Canada at the end of August and beginning of September.

James Cornet, mine secretary of the Consolidated Main Reef Mine, is proceeding, as local secretary, to the North Venezuela Petroleum Co. Mr. and Mrs. Cornet left Johannesburg in the spring of this year, sailing from Capetown. They will call at Trinidad for some months.

C. E. Cairnes, of the Canadian Geological Survey, will this season complete his detailed study, begun in 1925, of the geology of the silver-lead-zinc ore deposits of the Slocan mining area of British Columbia, and will also examine manganese deposits near Kaslo, B. C.

Howard T. James has been appointed provincial mining engineer for No. 1 Mineral Survey District of British Columbia. Dr. James is a graduate in mining from the University of British Columbia and has taken a post-graduate course in geology at Harvard. He has done field work for the Canadian Geological Survey and for the Britannia Mining & Smelting Co.

C. J. N. Jourdan, Inspector of Mines for the Pretoria district, in South Africa, will contribute a paper (with the consent of the Union Minister of Mines) to the Empire Mining and Metallurgical Congress to be held in Canada this year. The paper will deal with the principal mineral resources of the Union of South Africa.

Dean G. J. Mackenzie, and **Prof. T. Thorvaldsen**, of the University of Saskatchewan, have been awarded the Plummer gold medal for 1926 by the Engineering Institute of Canada, for

their work in arresting the progress of decay in concrete. Dean Mackenzie and Professor Thorvaldsen have discovered a partially successful process which it is hoped will be perfected by a little further research.

Dean L. S. Grant of the Colorado School of Mines has been granted a year's leave of absence, effective Sept. 1, 1927, so that he may accept the managership of the huge McElRoy ranch at Odessa, Tex. The ranch is owned by the Franco-Wyoming Co. Dean Grant is a graduate of the Colorado School of Mines and has been head of the department of mining since 1919. His place will be filled temporarily by **Prof. Jesse R. Morgan,** head of the department of languages and economics.

Frank Whiteley, son of E. E. Whiteley, general superintendent of the Calumet & Arizona Mining Co., at Bisbee, Ariz., has been awarded one of the six national scholarships in chemistry at Yale University, by the American Chemical Society, which sponsored the awards offered by Francis P. Garvan, of Washington, D. C. The four-year scholarship, which includes tuition and other expenses, is estimated at $5,000. The essay which won the prize for young Whiteley was on "Chemistry in the Copper Industry."

Prof. R. C. Wallace, of the University of Manitoba, has been appointed Commissioner of Mines for Manitoba. His duties will be to co-operate with the Industrial Development Board, the Chamber of Mines, and other mining bodies for the development of the provincial mineral resources. Dr. Wallace, who formerly occupied the position of commissioner for northern Manitoba for five years, is considered an outstanding authority on Manitoba mining. He will retain his position at the university while acting as mining adviser to the government.

Carl Davis, mining engineer and special representative of the Anglo-American Corporation of South Africa, after an examination for that company of the Mount Isa silver-lead field, Queensland, has left Australia on his return to South Africa, whence he will, after a short delay there, go on to England. **H. A. Titcomb** and **R. M. Geppert,** American mining engineers with offices in London, together with **F. L. Bosqui,** chief metallurgist on the staff of the Anglo-American Corporation, all of whom assisted Mr. Davis with the investigation of the Mount Isa mines, have also returned home.

C. H. Baxter, mining engineer, and formerly a member of the Michigan State Tax Commission, was recently elected professor of mining engineering at the Michigan College of Mining and Technology, Houghton, at a meeting of the board of control. Mr. Baxter is an alumnus of the college, with a distinguished record as an engineer. He was graduated in 1902, since which time he has been engaged in copper and iron engineering work. Until recently he was superintendent of the Loretto iron mine, at Vulcan, of which he was also a director. Mr. Baxter was appointed a member of the State Tax Commission in 1925, his term expiring May 1 of this year. He is the present head of the Lake Superior Mining Institute.

Obituary

Dr. Eugene Haanel, former director of mines for Canada, died at his home in Ottawa, Ontario, on June 26, following a brief illness. Dr. Haanel was born at Breslau, Germany, on May 24, 1841. He left Germany for America in 1857. He was educated at Breslau Gymnasium, and at Ohio University, receiving his master of arts degree in 1872, and his Ph.D. at Breslau, in 1873. During the Civil War he served as first lieutenant in the Federal army from 1861 to 1865. At the age of twenty-six he began his distinguished career as an educationist, in which capacity

Dr. Eugene Haanel

he trained many scores of brilliant men and women who today testify to his profound learning and to the breadth of his vision. His academic professorships include a chair of modern languages in Adrian College, Michigan; a chair of modern lanugauges, Hillside College, Michigan; a chair of natural science, Albion College, Michigan; a chair of natural science, Victoria University, Cobourg, Ontario, where he founded Faraday Hall, the first science hall in the dominion, and from 1888 to 1901 he held the chair of physics in Syracuse University, Syracuse, N. Y.

Dr. Haanel accepted the position of Superintendent of Mines, in the Canadian Department of the Interior, in 1901, and established the Assay Office at Vancouver, B. C., in 1902. He was instrumental in creating a Canadian Department of Mines in 1907, and from that date until his retirement in 1920 he ably directed the activities of the mines branch of that department. His retirement was due to a serious illness, which resulted in blindness. Especially worthy of note is his pioneer work in connection with the electric smelting of iron ores. This work has earned recognition wherever electric smelting has been conducted or considered throughout the world. He was the author of a vast number of reports and monographs dealing with scientific subjects. He was appointed by the Canadian Government in 1904 as chairman of the commission appointed to investigate the report on the electro-thermic processes employed in Europe for the reduction of iron ores and the refining of steel. This investigation resulted in the introduction of this method on the American continent. He also designed a shaft electric furnace for the reduction of iron ores which was later developed in Sweden and is used today for the reduction of iron ores in that country. Dr. Haanel was a member of many scientific institutions, including charter membership in the Royal Society of Canada; charter membership in the American Institute of Chemical Engineers, which he served as vice-president; and member of the Faraday Society, London, of which he was also vice-president.

An Appreciation

Dr. Charles Camsell, deputy minister and director of the Canadian Department of Mines, expressing his appreciation of the life and work of the late Dr. Eugene Haanel, former director of the Mines Branch, Federal Department of Mines, whose death occurred at his home in Ottawa on June 26th, said recently to a representative of this journal:

"The mining fraternity throughout Canada will deeply regret the passing of the late Dr. Haanel. His work has been of inestimable value not only to the Mines Department but to the country at large. Many years ago, when the mining industry of the dominion commenced to show signs of important developments, Dr. Haanel was invited to accept the position of Superintendent of Mines by Sir Clifford Sifton, a former pupil and at that time Minister of the Interior in the Laurier government. Dr. Haanel entered upon his duties with all the vigor and thoroughness which had marked his former activities, and the success that attended his efforts was such that, in 1907, when the Federal Department of Mines was established, he was appointed director of the Mines Branch. This government institution, organized by him, expanded under his able direction, his ambition being realized by the building up of a branch which, through its laboratory work and field investigations, is rendering a great service to the people of Canada.

"A notable incident in Dr. Haanel's life is that though he was totally blind during the last five or six years, he never lost courage. He accepted his affliction philosophically and continued to display the greatest interest in everything of importance that was happening. His chief characteristic was his administrative ability. He was an excellent organizer.

"Dr. Haanel, whose motto was service, will long be remembered by the people of Canada as one of her distinguished servants."

W. W. Brent, since May, 1924, with the United Verde Copper Co., at Jerome, Ariz., was killed recently in the company's mine at that place. Mr. Brent was a graduate in mining geology of the University of Nevada. At the time of his death he was acting as assistant to the chief engineer of the company's steam-shovel mine.

Market and Financial News

How the Spanish Government Is Aiding Lead Producers

By Courtenay DeKalb

THE DECLINE in the quotations for lead resulted in a meeting of independent producers at Linares, Spain, on April 18 for memorializing the government. It was pointed out that the industry was threatened with incalculable losses and the consequent emigration of skilled miners in search of work, unless measures were taken promptly to avert further disaster. The Government of Spain responded on May 29 with a "decree-law," No. 975, published in *La Gaceta*, of even date, page 1307.

Foreigners Control 60 Per Cent of Output

The preamble first sets forth that approximately 60 per cent of Spanish lead is produced by companies operating under foreign control. By virtue of consolidation of operations (the major part of that output being due to the operations of the Peñarroya company), the foreign producers had so far been able to withstand the decline in price. The independent producers, on the contrary, were unable to compete, and were threatened with extinction. Therefore, the logical counter move, as explained by the Minister of Fomento, Rafael Benjumea y Burín, would be to consolidate the independents, and to concede them certain advantages of collective buying and selling, together with proper technical control to ensure economies, with further aid during the crisis of low prices, in the nature of a temporary bonus, according to the ascertained needs of the individual mine. This "prima" or bonus is to endure one year dating from July 1, 1927. If possible to accomplish the salvation of a mine by temporary accommodation, loans will be extended for the purpose of providing better equipment and conditions of operation, to be repaid out of the product from the property. As far as possible the object is to equalize conditions at the various mines, partly by supplying deficiencies in equipment.

Two Syndicates Created

The law is too long to be given in full. It creates two syndicates, respectively, for the Linares-La Carolina district and for the Cartagena-Mazarrón district. It provides for supplementary syndicates under suitable conditions. These syndicates become associated through a separate federation, thereby welding them into a unit, for better market relations. Each syndicate elects its own board of directors, including representation by the Ministry of Fomento, and the government is also represented on the board of the federation. The syndication acts as a means of association for giving the status of a legal person in the contractural relations of the organization. Each syndicate is empowered to apply funds obtained from the government, or the Industrial Credit Bank, under authority of the Ministry of Fomento, to a number of objects. These include the acquisition or construction of a lead smelter for each district; the acquisition or construction of plants for manufacturing lead products; the establishment and maintenance in Spain or in foreign countries of offices for the sale of lead and lead products. The syndicates also plan to concede advances of funds to independent producers that, being bound by contracts for the sale of their concentrates, find it impossible to enter into the syndicate until these obligations have been discharged; to grant advances or loans to members of the syndicate for new constructions and improvements that will, on approval of the government for that purpose, result in cheapening the output. Funds will also be made available for the purchasing of ores and concentrates for treatment in the smelters; for establishing places for storage of ores and concentrates; for the purchase of ores from producers not members of the syndicate; and to make practicable the performance of all such acts as may facilitate the development of the industry, approved by agents of the Ministry of Fomento.

Syndicate Shall Specify Terms

It is provided that the syndicate, in respect to loans and advances, shall require suitable guaranties in these cases, and shall have power to fix conditions for such assistance, including, in the cases of producers operating on leaseholds, the previous modifications of the terms of the lease if necessary (to make economical production possible), together with the prolongation of the life of the lease if that will influence economy of operation. These provisions depend upon the association of not less than 80 per cent of the independent operators in the district to form a syndicate. All the mines syndicated, for the purposes of the law shall be collectively responsible in proportion to output (and in the cases of leaseholds the written contract of rental shall also be pledged), for advances made by the government or the Industrial Credit Bank, and no member of the syndicate shall be permitted to withdraw until its obligations to the government shall have been discharged. In case of the sale of a mine or a leasehold which is syndicated, the corresponding responsibilities of the former owner or lessee shall follow the property to the new owner or successor in interest to the lessee.

The metal production of a syndicated mine may not be withheld from the smelter established by the syndicate or the federation, and penalties are provided for the sale of ore or concentrate to smelters outside of the syndicate, unless express permission shall have been conceded by the syndicate.

Owing to the existence of mines with mixed galena and blende, particularly in the district of Cartagena-Mazarrón, a special section of the syndicate is given charge of such properties. The syndicates may effect payment for ores at the mine or on delivery to the smelter, the price being fixed by a commission formed by three representatives of the government and three of the syndicate, presided over by the president of the Mining Council, following the method set down by the mixed commission that heretofore has established the monthly prices for smelter settlements. (These were based upon current London metal quotations.)

Profit to Be Prorated

The smelter is to be managed on a cooperative basis, and the federation is to dispose of the output, the net product being distributed in accordance with the deliveries made to the smelter by the mine operators. Whenever a syndicated member shall have discharged its obligations to the syndicate it shall be free from all government intervention in its affairs. The government reserves the right to produce from its state-owned mine of Arrayanes, at Linares, and to have its concentrates smelted at the smelter of the syndicate, and to sell the products through the federation, on the same basis as the members of the organization, and to have equal representation on the governing board of the syndicate.

The government places at the disposition of the syndicates a maximum of three millions of pesetas (at current exchange equal to $425,000) to be charged against the fund for protection of industries according to the "decree-law" of April 30, 1924, estimated to be sufficient to cover deficits in costs of production, based, however, on a maximum cost of 800 pesetas per metric ton of lead, and a maximum of 100 pesetas per kilogram of contained silver. The cost price for the product of each mine shall be determined by each syndicate after government inspection, aided by representatives of the syndicate, and after giving the mine owner, or lessee, or the lessee and lessor, an opportunity for a public hearing, thus ascertaining the aid needed by each mine.

The petition made by the assembly of lead producers at Linares for a reduction of the export duty has not been conceded by this "decree-law." It has been suggested that such a concession, if made, should be accompanied by a reduction in the import duty on lead into France, which would be in the interest of the French company that now produces about 60 per cent of the lead of Spain.

The Economic Importance of the Swiss Mining Industries

Switzerland's mineral deposits occur, in most instances, in quantities and in places which do not tend toward an economical exploitation of these resources. With the exception of the iron ores, no others have any economic importance. The thin and widely separated deposits in the high Alps render economical exploitation practically impossible. In former centuries some of the Swiss mining industries were in a flourishing condition, but they gradually decreased in importance. In the gold and silver mining operations, with a few exceptions, more gold and silver was expended than was produced.

Coal mining expanded considerably during the war, and a large amount of capital was invested therein. The exploitation of slate coal has now entirely ceased, as the deposits are exhausted, and in the case of the brown coal mines, the seams of which are only 10 to 30 cm. thick, exploitation is not profitable at current coal prices. A little better outlook exists in anthracite mining. One mine is still under exploitation, and the coal mined there is shipped to the Lonza works situated in the Canton of Valais.

Asbestos mining has entirely ceased in Switzerland since the termination of the war. On the other hand, the largest part of the talc consumed within the country is mined in Switzerland. This industry is an outgrowth of the war. Of more importance is the asphalt mining industry. It employes about 200 men and not only satisfies the home demand but allows an exportation to the value of approximately 1,500,000 francs per annum.

Asphalt is the only mineral raw material exportation of which surpasses the importation. Of still greater importance are the Swiss salt mines. The Bex salt mines, in the Canton of Valais, produce about 5,000 tons a year, and the United Swiss Rhine Salt Works, near Basle, about 100,000 tons.

After the construction of the railways the Swiss metallurgical works, in spite of all endeavors, could not longer compete with foreign iron. As long ago as in 1849, a ton of Swiss bar iron cost 375 francs, though English or Belgian bar iron could be had at 261.50 francs. One after the other the Swiss blast furnaces were shut down, and at the beginning of the war only the blast furnace of Choindez was still in operation. The war, with its immense demand for pig iron, and the high prices for iron and steel, was responsible for new examinations and prospecting. The Gonzen iron mine was put in operation again and has been worked ever since. At present it exports between 70,000 and 80,000 tons of iron ore per year. The property contains at least 2,000,000 tons of 50 per cent iron ore. Examinations and surveys carried on for years in the Frick Valley indicate iron-ore deposits of at least 20,000,000 to 25,000,000 tons, averaging about 30 per cent iron. These deposits are sufficient to meet the Swiss demand for pig iron for the next fifty years at the present rate of consumption.

Noranda Issues New Stock

Shareholders of the Noranda Mines are advised that at the special meeting held in New York on June 24 authorization was given to increase the capital stock from 2,000,000 shares to 2,250,000 shares without par value. It has also been decided to issue 197,142 shares at $15 to stockholders of record July 15, in the proportion of one share of new stock for each ten shares held. Payment must be made by Aug. 15, and warrants not used in making subscription before that time will be void and of no value. Payment is to be made in three installments of $5 per share on Aug. 15, Sept. 15, and Oct. 15. On Dec. 31, 1926, 1,997,400 shares had been issued. Subsequent to this the Hollinger received 30,000 shares as a bonus for the $3,000,000 bond issue; N. A. Timmins, Inc., received 144,020 for his interest in the Alderson-Mac Kay and Waite-Montgomery properties; and 197,142 shares will be issued on July 15, which will leave 81,438 shares in the Treasury. The proceeds of the sale of the new stock will be sufficient to complete the townsite and smelter construction and provide funds for development and erection of a concentrating mill for the treatment of Alderson-McKay and Waite-Montgomery ores.

Statistical Notes

Chile Copper Co., during the three months ending March 31, 1927, treated 2,329,927 tons of ore averaging 1.515 per cent copper. Production for the three months was 56,275,993 lb., a monthly average of 18,758,664 lb., and approximately the same rate as for the preceding quarter. Production was 11,307,561 lb. less than the sales for the period.

The financial outcome of the Chile Copper Co. and Chile Exploration Co., combined, based on copper sales, shows for the three months, as follows:

Total pounds sold	67,583,554
Total gross receipts	$8,962,179.60
After deducting all expenses and charges, including depreciation, amortized d'scount on bonds, accrued income tax and accrued bond interest, a surplus remained of	$2,825,851.59

The two companies had available on May 31, 1927, $4,623,046.51, cash and call loans, against $3,400,380.37 in cash and marketable securities on Dec. 31, 1926.

Federal Mining & Smelting Co. proposes a reduction of capital by retiring 40,000 shares of preferred and 9,600 share of common stock now owned by the corporation. If the proposed reduction is approved, outstanding stock will consist of 80,000 shares, par $100, of preferred stock, and 50,400 shares of common stock, par $100.

The Treadwell Yukon Co., a subsidiary of the Bunker Hill & Sullivan and a 50 per cent owner of the Errington Mines, in the Sudbury district, will soon have its stock listed on one of the Toronto stock exchanges. The work done so far in the Sudbury district demonstrates that a more rapid and intensive campaign is justified, and if this work proves that the property is to be fully equipped, it is proposed to raise new money. With this end in view the Treadwell Yukon has been authorized to increase its capital by an issue of 100,000 shares of 6 per cent cumulative preferred stock of a par value of $100, plus bonus payments of the same dividend as may be paid from time to time on the common stock.

Michigan Iron mining companies produced 15,246,932 tons of ore during the year 1926, according to the state mine appraiser. The following figures show the allocation of the costs based on the average value at Lake Erie ports:

	Per Cent
Cost of Mining:	
Labor	23.94
Supplies	11.37
Total	35.31
Deferred Mining Cost	2.40
Taxes:	
General property	5.77
State corporation	0.23
Total	6.00
General Overhead:	
General office	1.12
General superintendent	0.91
Fire insurance	0.10
Contingent	0.21
Depreciation	2.90
Total	5.24
Transportation:	
Rail	18.77
Boat	17.61
Cargo insurance	0.05
Total	36.43
Marketing:	
Selling expense	1.29
Analysis	0.08
Total	1.37
Royalty	7.60
Interest	1.15
Margin of sale under Lake Erie price	1.50
Net operating profit	3.10
	100.00

The average realization based on Lake Erie analysis value was $4.179, leaving, after deducting "ore costs" of $3.623, a mine operating profit of $0.557. Royalty and interest charges are given as $0.366, making a net operating profit of $0.191.

Michigan Iron ore was produced during 1926 at a labor cost of almost exactly $1 per ton, according to figures compiled by the state mine appraiser. The following figures summarize operations:

Tons of ore mined in 1926	15,246,932
Tons of ore shipped 1926	16,810,160
State and local taxes paid by active and inactive mines	$3,679,316
State and local taxes per ton mined	$0.2413
Average number of days worked	278
Average number of men employed per day	11,302
Average daily wage	$4.856
Average yearly earning	$1,350.22
Tons per man per day	4.85

Bingham Mines Company reports operating profit for the first four months of 1927 as $184,648 on 50,000 shares, or $3.69 a share, compared with $1.83 a share for the same period during 1926. Profit of the Eagle and Blue Bell, 97 per cent of which is owned by the Bingham Mines Co., for the first four months of 1927 was $5,807.

Union Minière will cut its rail cost of transporting copper nearly in half according to a statement of the Belgian Colonial Minister. This report says that on the completion in June, 1928, of the railway line from Bas Congo to Katanga the Union Minière will be able to transport copper from the smelters to Matadi at a cost of 1,410 fr. per ton, compared with 2,724 fr., the cost of transport from Katanga to Beira.

The Market Report

Copper, Zinc, and Tin Markets More Active; Little Change in Lead or Silver

New York, July 13, 1927—Copper and zinc have been sold in larger volume in the week ending today than for some time, and prices for each of these metals are somewhat improved. Lead has been steady since the price declined last Thursday, and a fair amount of business has been done. Prices for prompt tin have declined a little further, and dealers have lent more than the accustomed activity to the market. Silver is virtually unchanged.

Copper Goes Above 12½c.

Copper was still available last Thursday at 12¼c., delivered at Connecticut points, and a good tonnage was sold, though there was a general tendency to mark prices up to 12⅜c., and some business was also done at that level. All of the 12¼c. copper had disappeared on Friday, 12⅜c. being uniformly asked for Eastern deliveries, and 12¾c. in the Middle West. Business continued very satisfactory to and including Monday, but yesterday and today demand has moderated perceptibly. However, the total for the week is the largest since the week ending June 1. Yesterday and today, most sellers continued to quote 12⅜c., delivered, but scattering sales of small lots were made at slight concessions, ranging from 12.55 to 12.60c., also. Deliveries have been pretty well distributed among July, August, and September, and the business has been well diversified as to consumption.

The statistics for June, which greeted the trade this morning, were open to various interpretations. On the bullish side may be noted the gradual decrease in total world stocks of copper in recent months, these now being less than 400,000 tons, and indicating that more copper is being consumed than is being produced; the decrease in refined stocks in North and South America from 108,079 tons at the end of May, to 96,360 at the end of June; and the increase in the export shipments from 46,979 tons in May to 61,487 tons in June. On the other hand, pessimists gloat over the facts that domestic shipments were the lowest for any month since last December and have decreased for four successive months; and that mine production is showing no tendency to decrease as expected. The daily rate of primary U. S. copper production actually increased slightly in June, from 2,310 to 2,318 tons. In March it was as low as 2,236 tons.

Daily Prices of Metals

July	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L
7	12 30	62 125	63 875	6 20	5 95	6 20
8	12 40	62 00	63 625	6 20	5 95	6 15@6 175
9	12 40	62 00	63 625	6 20	5 95	6 15
11	12 40	61 25	63 25	6 20@6 25	5 95@6 00	6 15@6 20
12	12 35@12 375	61 375	63 625	6 20	5 95	6 175@6 20
13	12 35@12 40	61 625	63 75	6 20	5 95	6 15@6 175
	12 373	61 729	63 625	6 204	5 954	6 173

Average prices for calendar week ending July 9, 1927, are: Copper, 12.315; 99 per cent tin, 62.500; Straits, 64.025; N. Y. lead, 6.240; St. L. lead, 5.970; zinc, 6.158; and silver, 56.100.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
7	53 3/4	54 1/4	59 3/4	287	280 7/8	23 3/16	23 9/16	28	27 13/16
8	53 3/4	54 1/4	59 3/4	286 1/4	280 1/2	22 7/8	23 5/16	27 11/16	27 1/2
11	53 11/16	54 1/4	59 3/4	282 1/2	278 1/2	22 15/16	23 7/16	27 1/2	27 5/16
12	53 11/16	54 1/4	59 3/4	282 1/2	278 3/4	22 15/16	23 3/8	28	27 3/4
13	53 11/16	54 1/4	59 3/4	284	279 3/4	22 13/16	23 3/16	27 3/4	27 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
7	4.85 1/8	56	25 13/16	84s11 1/2d	11	4.85 1/4	56 1/8	25 15/16	84s11 1/2d
8	4.85 1/8	56 1/8	25 7/8	84s11 1/2d	12	4 85 1/4	56 1/4	26	84s10 1/2d
9	4.85 1/8	56 1/8	25 7/8	.....	13	4 85 1/8	56 1/8	25 7/8	84s11 1/4d
					Avg.		56.125		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forencon. Cables command one-half cent premium.

Lead Buying in Good Volume

Buying of lead during the week has been fully up to the average in volume. The weakness in London which threatened to divert Mexican ore lead to the domestic market caused the American Smelting & Refining Co. to cut its official contract price for New York delivery from 6.30c. to 6.20c. on Thursday, July 7. On the same day the leading interest in the West reduced its price to regular customers from 6c. to 5.95c. It is reported that some second-hand lead was available at slight concessions from 5.95c., but with the exception of two orders no producer is known to have shaded the figure. On the other hand, even higher prices were obtained in some instances. A check-up of the first half year indicates that sales of white lead were fully up to those of the corresponding period in 1926, although that was somewhat below the average for the last five years. Storage-battery manufacturers are showing more interest in the market, as are makers of ammunition and blue-lead products. With definite indications that smelter production is declining, most producers are inclined to the belief that the market has reached bottom. Not since the summer of 1923, when New York lead for ten days sagged to 6c., has the metal been as low as at present. Of course, if London continues to decline and domestic producers persist in excluding ore lead, the price here must go still lower.

Zinc in Big Demand

Galvanizers were active buyers of zinc in the week ending today, the total sales for the week being the

largest since early January. Several large lots for delivery during each of the next three months aided materially in swelling the total. Most of the business has been done at 6.15c., though as low as 6⅛c. was registered last Saturday; a good business has also been done at 6.175c., and a little at 6.20c. and 6¼c. Spot high-grade continues nominal at 8c., delivered in the East. Statistics issued by the American Zinc Institute, in tons of 2,000 lb., follow:

Stock, June 1	42,046
Produced	49,718
Shipped	47,906
Stock, June 30	43,858
Shipped from plant for export	4,784
Sold but not delivered, June 30	14,953
Retort capacity, June 30	138,444
Average number of retorts operating in June	80,373
Number retorts operating June 30	80,047

Tin Slightly Easier

Sentiment in the tin market is that prices should ease somewhat. Stocks in British warehouses are expected to increase about 600 tons and the premium on spot in London during the last week has decreased from £9 to about £4 5s., reflecting an easier position on the other side. Buying in the domestic market has been confined mostly to dealers, with prices showing little change.

Foreign Exchange

Closing cable quotations on Tuesday, July 12, were: francs 3.91½c., lire 5.43c., and marks 23.735c. Canadian dollars ⅛ per cent discount.

Silver Steady and Quiet

In the last week the silver market worked steadily higher through Tuesday, as a result of buying orders from China. On Wednesday, however, London prices declined ¼d., and the local market reacted in sympathy. The market appears steady at the lower level, with demand light.

Mexican dollars (Old Mexican pesos): July 7th, 42⅜c.; 8th, 9th, and 10th, 42½c.; 12th, 42⅝c.; 13th, 42½c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Per lb., 98 or 99 per cent grade, price of leading interest, 26c.; outside market, 25.30@25.80c.

Antimony—Per lb., duty paid, New York: Chinese brands, range for the week, spot business, 12@11⅞c. August arrival about ¼c. higher. Cookson's "C" grade, spot, 17¾c. Market dull and prices largely nominal. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

Bismuth—Per lb., New York, in ton lots, $1.85@$2.10. London, 8s.

Cadmium—Per lb., New York, 60c.

Iridium—Per oz., $107@$110 for 98 @99 per cent sponge and powder.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade) for single lots of spot metal.

Palladium—Per oz., $52@$54. Small lots bring up to $58. Pure metal as a constituent of crude platinum, nominal.

Platinum—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $72. Open market cash sales of large lots, in New York, $63.50@$65.50. Pure metal as a constituent of crude platinum, nominal at $62. Very dull.

Quicksilver—Range for week, $119@$120, nominal, per 76-lb. flask. Market still dead. San Francisco wires $121. London, £20½@£21½.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the issue of July 9.

Zinc Blende Advances—Price of Lead Ore Lower

Joplin, Mo., July 9, 1927

Blende	Per Ton
High	$44.40
Premium blende, basis 60 per cent zinc	$43.00@ 44.00
Prime western, basis 60 per cent zinc	41.00@ 43.00
Fines and slimes, 60 per cent zinc	39.00@ 41.00
Average settling price, all zinc	40.48

Galena	
High	$81.00
Basis 80 per cent lead	75.00
Average settling price, all lead	79.38

Shipments for the week: Blende, 8,206; galena, 850 tons. Value of shipments for the week, $399,650.

Overlapping prices on zinc were occasioned by shifting the usual methods of buying, little regard being given to grades in making price offerings. The ore is needed by the smeltermen, and they are purchasing it on the best terms possible, with less regard to an assay basis than ordinarily observed.

Lead prices were lowered in response to the decline in pig lead, but, as one buyer stated, they could get as much lead on $70 basis as on a $75 basis, producers refusing to dispose of stocks.

Platteville, Wis., July 9, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$44.25
Lead Ore	
Lead, basis 80 per cent lead	$80.00

Shipments for the week: Blende, 1,211 tons; lead, none. Shipments for the year: Blende, 34.971; lead, 890 tons. Shipments for the week to separating plants, 2,011 tons blende.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c., Caucasian, washed, 53@55 per cent, 40c. Chemical grades unchanged from quotations in the July 9 issue.

Tungsten Ore — Per unit of WO₃, N. Y.; Wolframite, $10.50@$10.60. Western scheelite, $10.75@$11. Market dull and prices largely nominal.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the July 9 issue.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz, Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the July 9 issue.

Mineral Products

Arsenious Oxide (White Arsenic)—3¾c. per lb. More buying with tendency toward strength. London, Cornish white, per long ton, £15½.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate and **Zinc Oxide** are unchanged from prices in the July 9 issue.

Ferro-Alloys

Ferrochrome—Per lb. of contained chromium, 60@70 per cent chromium, 4@6 per cent carbon, 11½c.

Ferromanganese—Domestic and foreign, 78@82 per cent, $90 per long ton, furnace or duty paid. Consumers well covered for early needs. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

Ferrotungsten—95@98c. per lb. of W contained, f.o.b. works. Dull.

Ferrocerium, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the July 9 issue.

Metal Products

Rolled Copper—Sheets, 21½c.; wire, 14⅜@14½c. f.o.b. mill.

Lead Sheets—Full rolled, 10c. per lb.; clipped, 10½c.

Nickel Silver—28½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 18½c. per lb.; rods, 15½c.

Zinc Sheets—9⅜c. per lb., f.o.b. mill.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and **Zirkite** are unchanged from quotations in the July 9 issue.

Increase in Steel Bookings

Pittsburgh, July 12, 1927

The U. S. Steel Corporation's unfilled tonnage decreased 405,191 tons in May and increased 2,305 tons in June. About two-fifths of the change was attributable to decreased shipments and approximately three-fifths to increased bookings.

Steel ingot production in June was about 3,490,000 long tons, representing 13.7 per cent decrease from May and 6.5 per cent decrease from the preceding June.

Steel prices are holding remarkably well and are even steadier than month ago.

Pig Iron. — There was less third quarter and second half contracting in pig iron than usual, some engagements being carried over. Prices in the various markets average a dollar a ton lower than a year ago and there are no prospects of advances. The valley market remains at $18.50 for bessemer, $17.50 for basic and $18 for foundry iron.

Connellsville Coke. — The market is steady and dull, with production at a low rate. Spot furnace, $3; spot foundry, $4@$4.75.

Review of Current Statistics

By A. B. Parsons
Associate Editor

MONTHLY AVERAGE PRICES for copper and lead continued their downward course during June. Copper averaged 12.370c., f.o.b. Eastern seaboard refinery, compared with 12.621c. in May; and the corresponding figures for New York lead were 6.414c. and 6.616c. Except for an advance in each metal in the lone month of March, the downward trend has been persistent and consistent since August, 1926. Zinc and silver averaged somewhat higher in June than in May, whereas nickel and aluminum remained unchanged and the decline in tin was inconsequential.

The *Engineering and Mining Journal's* Weighted Index of Non-Ferrous Metal Prices continued in the direction that is grievous to mine operators. The figure is 95.55 on the basis of a composite for the years 1922-1923-1924 as 100. Not since the year 1922 has the general level of metal prices been so low. The Index for the first half of 1926 was 108.60, compared to 98.65 for the corresponding period of the present year.

That this situation is not as bad as is indicated by these bare figures becomes evident at once when the accompanying chart showing Irving Fisher's price index is examined. The average for the first half of 1926 is approximately 154; that for the first half of 1927, about 141.5. This is a decline of 8.1 per cent, whereas the decline in the Metal Price Index is 9.3 per cent.

The trouble is that lower metal prices affect adversely and immediately current income of mining companies; whereas, on the other hand, the effect of a lower level of general commodity prices becomes operative very gradually. Wages, for example, theoretically should become lower as the price level declines. Eventually they may do so, or at least the wage cost per unit of mine production will be lowered. This, unfortunately, is not reflected in the balance sheet for current mine operations. However, all producers of raw materials, all exploiters of natural resources, are subject in greater or less degree to much the same set of conditions, and mining companies cannot reasonably complain on this score.

The question arises: could producers of metals prevent the prices of their products from declining in synchronism with the decline in general commodity prices? Perhaps they could if the rate of aggregate production could be regulated. To accomplish this the industry would have to perform with something approaching unity, an achievement that is unlikely if experience is any criterion.

Nevertheless in the data on the charts on page 117 appear definite symptons of some decline in production of copper, lead and zinc, particularly in the Western hemisphere. The data of world production on page 118 are not entirely reassuring with respect to copper and zinc. The situation seems to be that, although industrial consumption of metals is at a rate somewhat lower than the average for 1926, the rate of production has not been decreased in corresponding amount. Shall the industry wait for dire necessity to force curtailment?

By and large, economists and industrial forecasters are much more optimistic in their estimates of industrial activity in the immediate future than they were several months ago. The consensus of opinion is that consumption of raw materials, including metals, during the second half of 1927 should approximate closely that during the second half of the active year that preceded it.

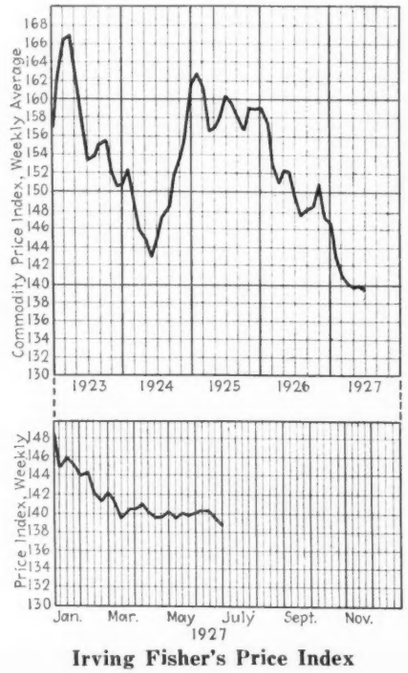
E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74

	1925	1926	1927
December	114.15	102.31	
January	116.38	112.66	100.46
February	113.50	111.91	100.01
March	110.20	108.95	100.84
April	104.75	105.93	98.63
May	105.34	105.43	96.41
June	107.19	106.68	95.55
Average first six months	109.56	108.60	98.65

Some further slight decline in the Weighted Index of Non-Metallic Mineral Prices is accounted for by lower levels for fluorspar. Competition from European spar, imported in spite of a duty of $5.60 per gross ton, has forced price-cutting by domestic producers in some directions. The decline in fluorspar is offset to an extent by better prices for barytes than prevailed a month ago.



Irving Fisher's Price Index

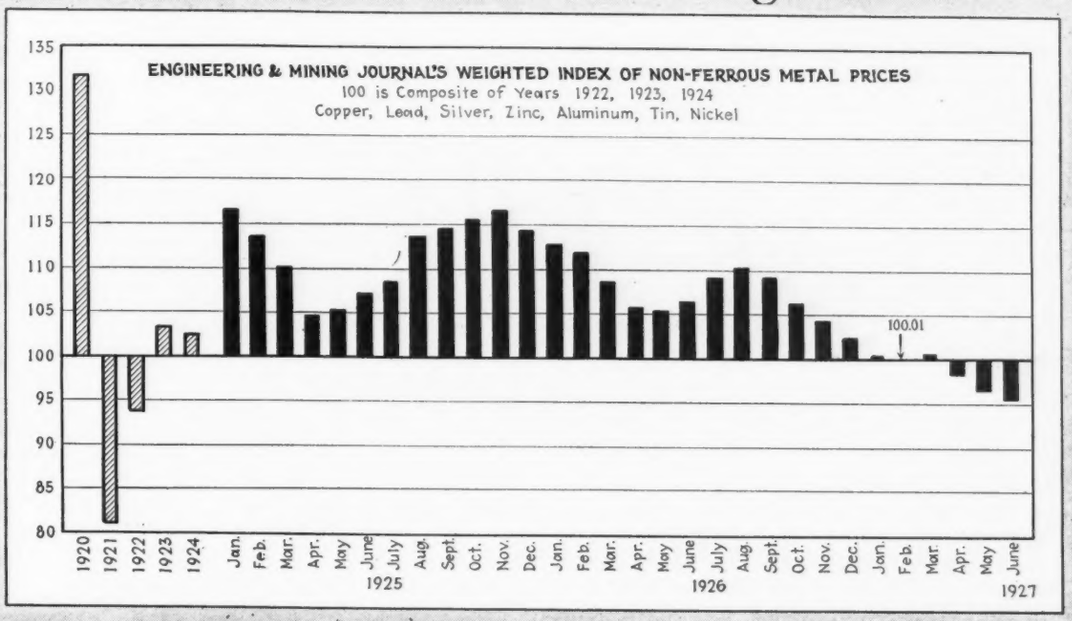
June saw a marked decline in prices of mining-company shares, this trend paralleling that of the general list of industrial and miscellaneous stocks. The average at the end of June was in the neighborhood of 5 per cent lower than at the end of May. With respect to the Index for the seven mining-smelting-manufacturing companies represented in chart on page 117 the decline is considerably more sharp, amounting to almost 10 per cent. It should be explained, however, that the biggest factor in the decline was International Nickel, and the third biggest National Lead, in both of which peculiar situations existed which had sent prices skyward. The Nickel shares, beyond reasonable doubt, have been subject to pool operations in Wall Street that inflated them beyond levels warranted by intrinsic value of the enterprise. Apparently they have come part-way back to earth. National Lead is quoted on the basis of 309,000 shares of stock, the number outstanding after the recent stock dividend. This dividend included a half share of a new issue of preferred stock as well as a half share of common, so that the shrinkage in the aggregate common share valuation was inevitable.

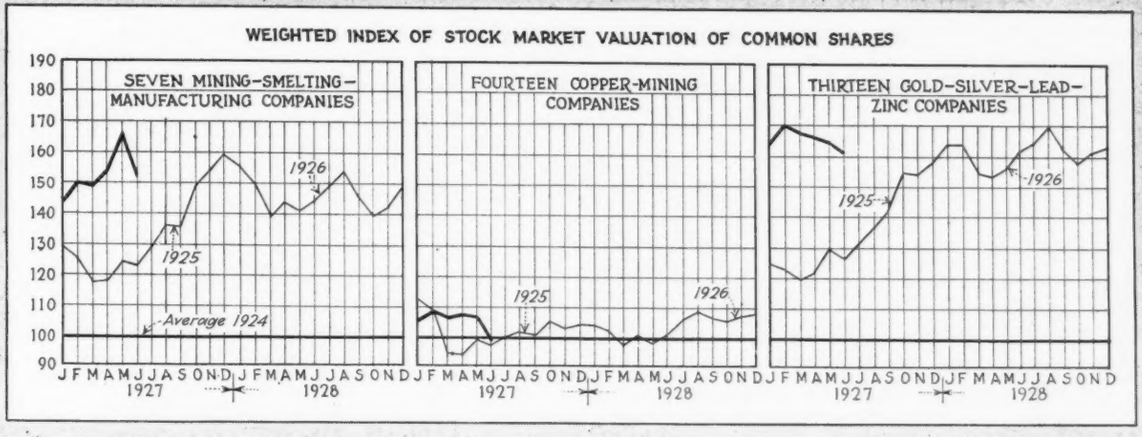
At the same time, without exception, each of the other stocks in the group, in which no unusual factors operated, also declined. Anaconda was the leader, followed a good distance behind by A. S. & R., American Metal, and New Jersey Zinc, closely bunched.

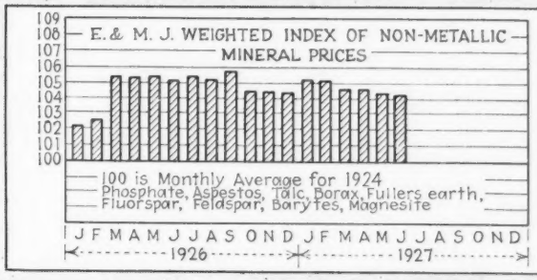
Copper shares, with the exception of four of the smaller companies that improved slightly, participated in the general downward trend. The Index is now at a lower level than at any time in the past year. Kennecott, Chile, New Cornelia, Nevada "Con.," Granby, and Inspiration contributed to the decline, in the order named. The behavior of the copper stocks during the last few months lends color to the theorem "As the metal goes, so go copper shares."

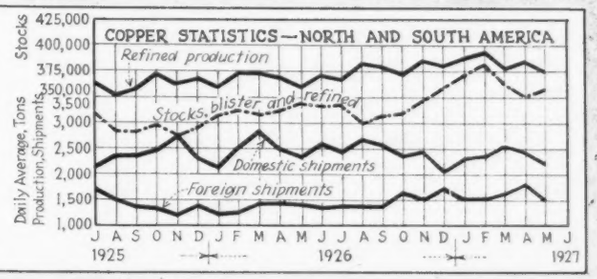
The miscellaneous group, as usual, shows more erratic variations than the others, though a net decline resulted for June. The principal factors were Hollinger and Lake Shore, Ontario gold producers. Markets for most of the Ontario mining stocks have been inflated by an enthusiastic public to levels that many think unwarranted. Though the two mentioned unquestionably are among the best, some recession in share quotations probably is a good thing. Incidentally, the situation in International Nickel may be in part a reflection of the general market position in Ontario. The two important gold producers in the United States, Cresson and Homestake, improved during the month. The same is true of Tintic Standard, Silver King Coalition, Hecla, and Federal M. & S. Apparently the persistent decline in metal prices has not discouraged those interested in these lead-silver producers in the West.

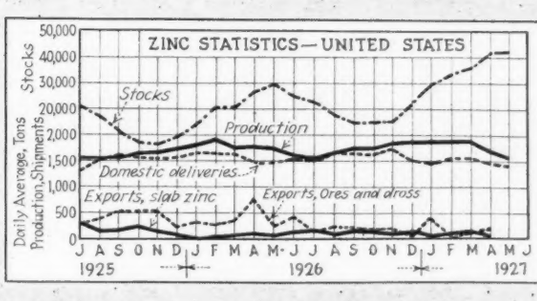
E & M.J. Statistics of the Mining Industries

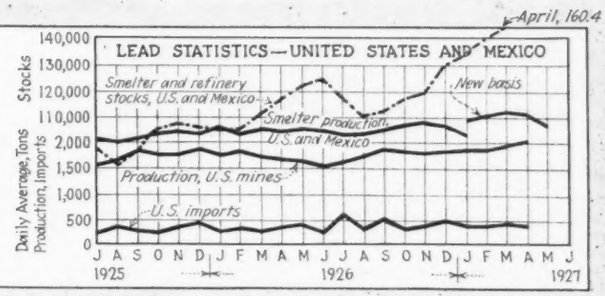

ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922, 1923, 1924
Copper, Lead, Silver, Zinc, Aluminum, Tin, Nickel
100.01
1920 1921 1922 1923 1924 1925 1926 1927



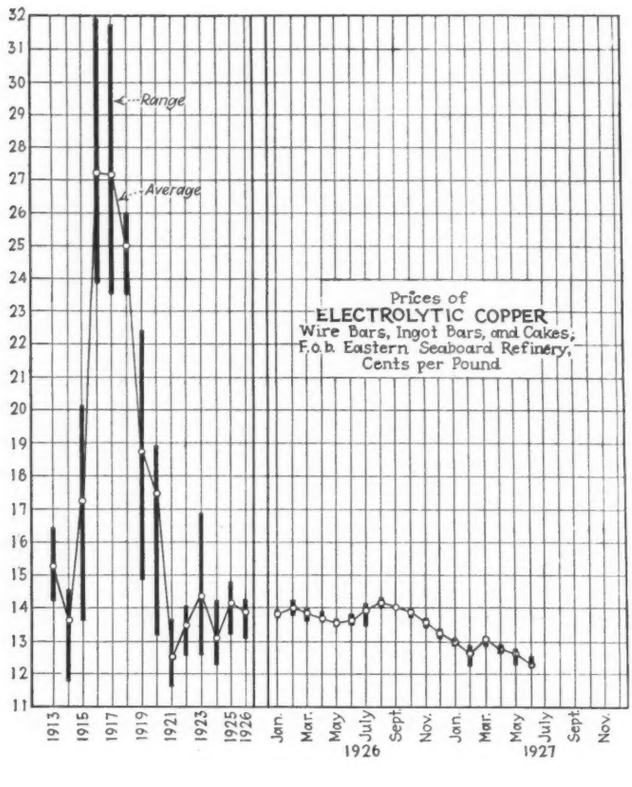

E. & M. J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers earth, Fluorspar, Feldspar, Barytes, Magnesite
1926
1927

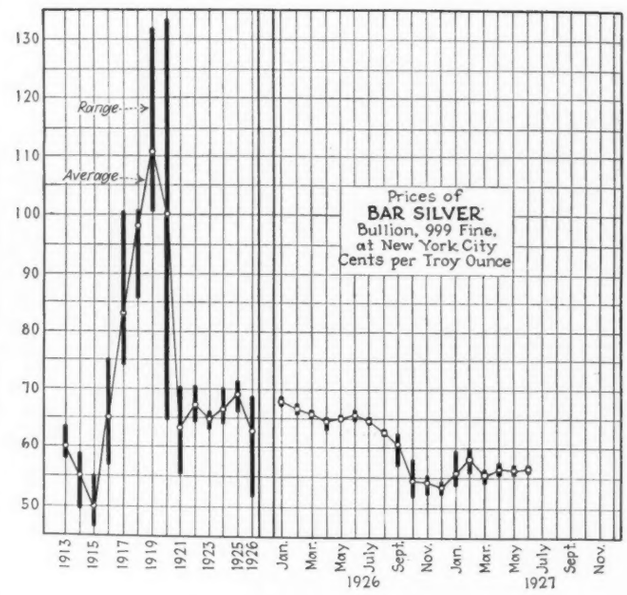


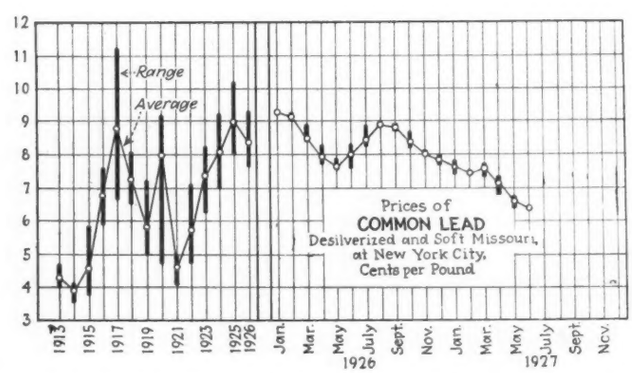


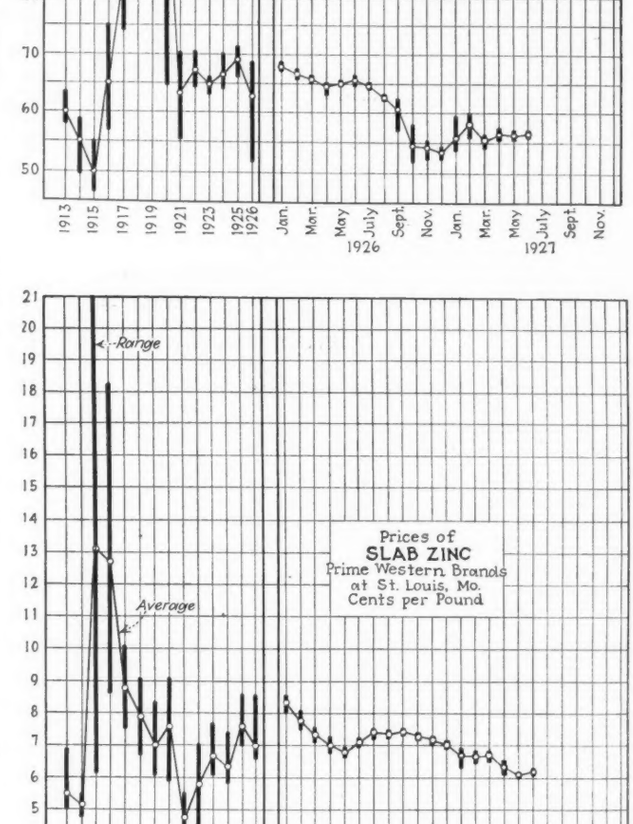


Metal Price Curves

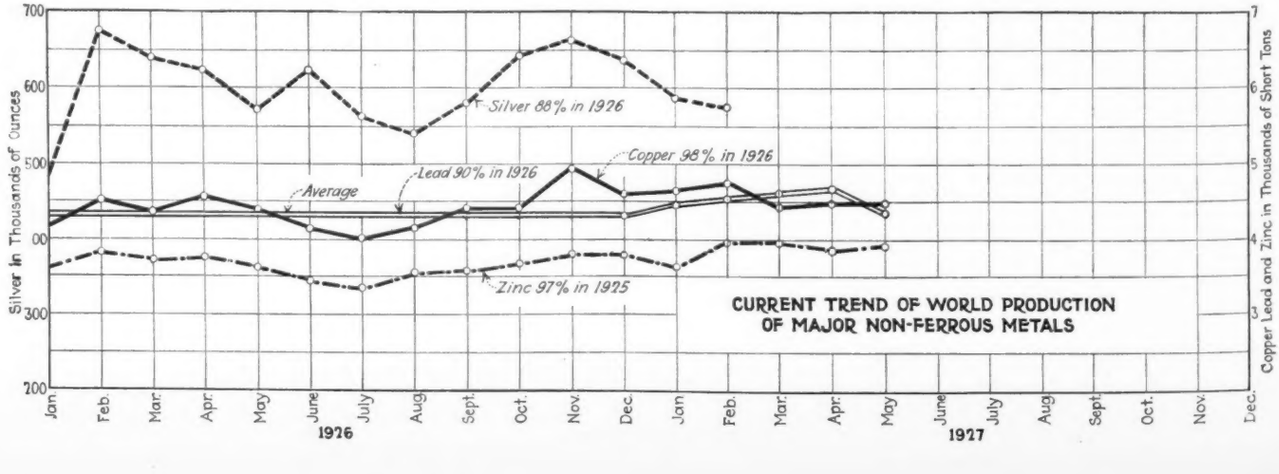








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926; and accordingly a horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.



Mining Stocks—Week Ended July 9, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	44	43⅛	43⅛	Jy.16, Au.22 Q	0.75
Arcadian Consol.	Boston	...	...	*30	.....	.....
Ariz. Com'l	Boston	5⅛	5¼	5⅛	Ja. 7, Ja. 28	0.50
Calaveras	N. Y. Curb	...	...	1⅜	.....	.....
Calumet & Arizona	New York	64	63¾	64	Ju. 13, Ju. 20 Q	1.50
Calumet & Hecla	Boston	14⅜	14⅛	14⅛	My.31, Jn.15 Q	0.50
Cerro de Pasco	New York	59⅛	58⅛	59	Jy.14, Au.1 Q	1.00
Chile Copper	New York	33⅜	33⅛	33⅛	Jn.3, Jn.30, Q	0.62½
Con. Coppermines	N. Y. Curb	2⅛	2⅛	2⅛	.....	.....
Copper Range	Boston	12⅛	12	12	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*48	*42	*46	.....	.....
East Butte	Boston	1½	1½	1½	Dec., 1919	0.50
Granby Consol	New York	36⅛	35½	36	Jn.15 Jy. 1 Q	1.00
Greene-Cananea	New York	43⅛	40	42⅝	Nov., 1920	0.50
Howe Sound	New York	36	35	35⅜	Apr.1,Apr.15 Q	1.00
Inspiration Consol	New York	13⅛	13	13⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	...	...	2½	.....	.....
Isle Royale	Boston	9⅛	9⅛	9⅛	Fe.4, Fe.19, Q	0.50
Kennecott	New York	62⅜	61	61	Ju. 3, Jy. 1 Q	1.25
Magma Copper	New York	33	32⅜	33	Jn.30, Jy.15, Q	0.75
Mason Valley	N. Y. Curb	*93	*65	*93	.....	.....
Miami Copper	New York	13⅞	13⅜	13⅜	Au.1, Au.15 Q	0.37½
Mohawk	Boston	39⅛	37⅛	38⅛	Ap.30, Jn.1 Q	1.00
Mother Lode Coal	New York	2⅜	2⅜	2⅜	Jn.10, Jn.30	0.25
Nevada Consol	New York	13⅝	13	13⅝	Jn. 3, Jn. 7 Q	0.37½
New Cornelia	Boston	20⅛	20	20	My.6, My.23 Q	0.50
Noranda	N. Y. Curb	22⅜	20⅜	22⅜	.....	.....
North Butte	Boston	*99	*90	*99	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*85	*77	*78	Sept. 1926	0.03
Old Dominion	Boston	11⅞	11⅛	11⅞	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	...	...	114	Jn.18, Jy.1 Q	1.50
Quincy	Boston	13⅛	13⅛	13⅛	March, 1920	1.00
Ray Consolidated	New York	14⅛	14¼	14⅛	Ap.20, Ap. 30	0.25
St. Mary's Min. Ld	Boston	19⅛	19	19	Fe.10, Ma.10	2.00
Seneca Copper	New York	1⅛	1⅛	1⅛	.....	.....
Shattuck-Denn	Boston Curb	4⅜	4⅛	4⅛	.....	.....
Tenn. C. & C	New York	8⅛	8⅛	8⅛	My.31,Ju.15, Q	0.12½
United Verde Ex	N. Y. Curb	23⅛	23	23⅛	Jy.6, Au.1 Q	0.75
Utah Copper	New York	...	...	115	Jn. 17, Jn. 30 Q	1.50
Utah Metal & T	Boston	*85	*85	*85	Dec., 1917	0.30
Walker Mining	Salt Lake	*51	*51	*51	.....	.....
NICKEL-COPPER						
Internat. Nickel	New York	63⅛	60⅜	61⅛	Jn. 16, Jn. 30 Q	0.50
Internat. Nickel pfd.	New York	...	...	109	Ap. 14, My. 2 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*20	*16½	*16½	April, 1927	0.005
National Lead	New York	100⅜	97⅜	100⅜	Jn. 10,Jn.30 Q	1.25
National Lead pfd	New York	132¼	132¼	132¼	My.10,Jn.15 Q	1.75
St. Joseph Lead	New York	38⅛	37⅛	37⅝	Se.10,Se.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	8	8	8	May, 1917	1.00
Am. Z. L. & S. pfd	New York	44	43½	43½	Nov., 1920	1.50
Butte C. & Z	New York	4⅛	4⅛	4⅛	De. 9, De. 24	0.50
Butte & Superior	New York	8⅛	8⅛	8⅛	Jn. 17, Jn. 30 Q	0.50
Callahan Zn-Ld	New York	1⅜	1⅜	1⅜	Dec., 1920	0.50
Consol.Lead&Zinc'A'	St. Louis	12⅛	12⅛	12⅛	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	26⅜	26⅛	26⅛	Au.15,Se.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	116	Jn.30, Jy.15 Q	1.50
New Jersey Zn	N. Y. Curb	181	180	181	Jn.20, Jy.9 QX	2.00
United Zinc	N. Y. Curb	...	...	*55	.....	.....
Yellow Pine	Los Angeles	*24½	*20	*20	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1½	1½	1½	.....	.....
Argonaut	Toronto	*28½	*26½	*28½	.....	.....
Barry-Hollinger	Toronto	*30½	*27	*27½	.....	.....
Consol W. Dome L.	Toronto	*7½	*6½	*6½	.....	.....
Cresson Consol. G	N. Y. Curb	2⅜	2⅛	2⅛	Ma.31,Ap.10 Q	0.10
Dome Mines	New York	7⅛	7⅛	7⅛	Jn. 30, Jy. 20 Q	0.25
Golden Cycle	Colo.Springs	†1.67½	†1.66½	...	My.31, Jn.10 Q	0.04
Hollinger Consol	Toronto	18.75	18.00	18.50	Jn. 29, Jy. 15 Q	0.10
Homestake Mining	New York	61	61	61	Jn. 24, Jn. 25 M	0.50
Kirkland Lake	Toronto	1.42	1.32	1.40	.....	.....
Lake Shore	Toronto	19.00	18.60	19.00	Jn.1, Jn.1 X	0.20
McIntyre-Porcupine	New York	26	25	26	My.2, Jn.1 Q	0.25
Portland	Colo.Springs	†*37	†*30	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	...	...	9½	Au.23-30 Am.Sh.	1.52
Teck-Hughes	Toronto	8.25	7.20	8.14	Jy.21, Au.1	0.10
Tom Reed	Los Angeles	*47	*40	*40	Dec., 1926	0.02
Tough-Oakes	Toronto	*40	*27	*29½	.....	.....
United Eastern	N. Y. Curb	*50	*45	*47	July, 1924	0.05
Vipond Cons	Toronto	*85	*75	*76	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	5.60	5.49	5.52	Ap.15,My.2	0.10
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	12	12	12	.....	.....
Con. Cortez	N. Y. Curb	*19	*19	*19	.....	.....
Con. Virginia	San Francisco	*3½	*3½	*3½	.....	.....
Dolores Esperanza	N. Y. Curb	...	...	*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2 1/16	2 1/16	2 1/16	Jn. 14, Jy. 5	0.08
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*29	*29	*29	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2 1/16	2 1/16	2 1/16	Ma.31, Apr.21	0.07½
West End Consol	N. Y. Curb	...	...	*7	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*45	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	1.10	1.04	1.08	May, 1920	0.03
Canadian Lorrain	Toronto	*14	*12¼	*13½	.....	.....
Castle-Trethewey	Toronto	*82	*75	*75	.....	.....
Coniagas	Toronto	4.00	3.75	4.00	May, 1924	0.12½
Keeley	Toronto	1.08	1.00	1.05	Fe.28, Ma.15 X	0.12
Lorrain Trout Lake	Toronto	*80	*73	*73	July, 1925	0.05
McKinley-Dar.-Sav	Toronto	*16	*14	*14	Oct., 1920	0.03
Mining Corp. Can	Toronto	3.15	3.00	3.15	Jn. 29, Jy.15	0.12½
Nipissing	N. Y. Curb	5⅞	5⅛	5⅞	Jn 30, Jy.20	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	3⅜	3⅛	3⅜	Ma. 25,Ap.4,QX	0.12½
Bingham Mines	Boston	43½	43	43½	Jn.27, Jy. 5 Q	1.00
BunkerHill&Sullivan	N. Y. Curb	94⅜	91	93⅜	My.31, Jn.4 X	0.75
Cardiff M. & M	Salt Lake	...	...	*45½	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	3.10	3.05	3.05	Nov., 1926 Q	0.10
Consti'nMng.&Mill'g	Spokane	*28	*25	*25	.....	.....
Erupcion	Boston Curb	*55	*50	*55	Jn. 25, Jy. 5 Q	0.07½
Eureka Lily	Salt Lake	1.47½	1.42½	1.45	.....	.....
Federal M. & S	New York	141	135	135	Jn.25, Jn.29 Spec.	$10
Federal M. & S pfd.	New York	94	92¾	94	My.25, Ju.15 Q	1.75
Hecla Mining	N. Y. Curb	15½	15	15	My.4, Ju. 15 Q	0.25
Highland-Surprise	Spokane	*13	*12	*12	.....	.....
Iron King Mining	Salt Lake	*57	*51	*51	.....	.....
Keystone Mining	Salt Lake	*24	*24	*24	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*18¾	*18¾	*18½	.....	.....
Lucky Tiger-Com	Kansas City	†7.00	†6.75	....	Jy.10, Jy.20	0.05
Mammoth Mining	Salt Lake	1.80	1.80	1.80	Jn.10, Jn.20 Q	0.05
Marsh Mines	Spokane	1.50	1.00	1.00	.....	.....
North Lily	Salt Lake	3.60	3.50	3.50	.....	.....
Park Utah	New York	6½	6¼	6½	Jn. 25, Jy. 1 Q	0.20
Plutus Mining	alt Lake	2.05	2.00	2.05	Ja. 10, Ja. 15 Q	0.10
San Rafael	San Francisco	...	...	*24	.....	.....
Silver King Coal	Salt Lake	7.85	7.80	7.85	Jn. 20, Jy. 1 Q	0.25
Silversmith	Spokane	*35	*29	*29	Oct., 1926 Q	0.02
Stratton Mines	Spokane	*51	*49	*50	.....	.....
Sunshine M. Co	Spokane	*90	*85	*90	.....	.....
Tamarack-Custer	Spokane	*27	*23	*25	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.12½	12.00	12.00	Jn.15, Jn.28	0.40
Utah-Apex	Boston	4½	4¼	4¼	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	49	47½	48	July, 1924	1.25
Cleveland-Clifs Iron	Cleveland	...	...	84	Jy. 15, Jy. 25 Q	1.00
Colorado Fuel & Iron	New York	95½	90⅜	92⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York	18⅜	18¼	18⅛	Dec. 6, Dec. 28	0.75
Inland Steel	New York	50⅛	49	49	My. 13, Jn. 1 Q	0.62½
Replogle Steel	New York	...	...	12⅛	.....	.....
Republic I. & S	New York	64	62½	64	My. 14, Jn. 1 Q	1.00
Republic I. & S. pfd.	New York	103⅜	103⅜	103½	Jn. 14, Jy. 1 Q	1.75
Sloss-Sheffield S. & I.	New York	118	117⅛	117½	Jn. 10, Ju. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	1.07	1.07	107	Jn. 20, Jy. 1 Q	1.75
U. S. Steel	New York	122½	1.20½	120⅜	Jn. 7, Jn. 29 Q	1.75
U. S. Steel, pfd	New York	133	132	133	My.2, My.28 Q	1.75
Virginia I. C. & C	New York	....	....	44	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	....	....	60½	Ju. 15, Jy. 1	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	...	...	30⅛	Ja. 26, Ja. 29	1.45
So. Am. G. & P. New.	N. Y. Curb	2⅜	2⅛	2⅜	.....	.....
Alum. Co. of Amer	Open Market	80½	79	80	.....	.....
Alum. Co. ofAmer.pf.	Open Narket	101⅜	101⅛	101⅛	Jn. 15, Jy. 1 Q	1.50
Vanadium Corp	New York	45½	44¼	45⅛	My. 2, My. 16Q	0.75
Patino M. & E	New York	22⅛	21⅜	22⅛	Ap. 27, My. 5	1 sh.
ASBESTOS						
Asbestos Corp	Montreal	23¼	22⅛	23	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	88⅛	87⅛	87¼	Jn.30, Jy.15 Q	1.75
SULPHUR						
Freeport, Texas	New York	70¼	68	68⅞	Jy. 15, Au.1 QX	1.25
Texas Gulf	New York	66¼	63¾	65½	Ju. 1, Ju. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	38¼	38¼	38¼	Au.20, Se.1 Q	0.75
Amer. Metal, pfd	New York	...	...	108	Au.22, Se.1 Q	1.75
Amer. Sm. & Ref.	New York	155	152	153	Jn.8, Au. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	125⅜	124⅜	125¼	Au. 1, Se. 1 Q	1.75
Consol. M. & S	Montreal	235	218½	227½	Jn. 30, Jy. 15 X	6.25
Newmont Mining	N. Y. Curb	77⅜	77½	77½	Jn.30, Jy.15 Q	1.00
U. S. Sm. R. & M.	New York	35	34¼	35	Jy. 6, Jy. 15 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	49¼	48⅜	49	Jy. 6, Jy. 15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

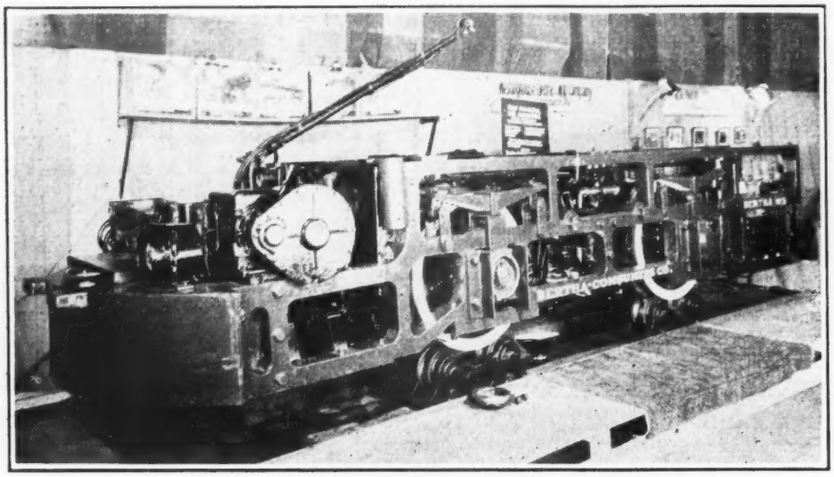
Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED JUNE 28, 1927

Name	High	Low	Last	Date	Last Div. Amount
Aramayo Mines (25 frs.)	84/4½	80/—	81/3	May, 1927	5 p.c. (†)
British Platinum (£1)	3/—	2/6	2/6	Feb., 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/5½	13/10½	14/—	Aug., 1927	6 annas*
Bwana M'Kubwa (5s)	5/10½	5/6	5/7½		
Camp Bird (2s)	4/3	3/9	3/10½		
El Oro (£1)	4/1½	3/11½	4/—	Nov., 1924	2½ p.c.*
Esperanza (10s)	—/1½	—/1½	—/1½		
Frontino & Bolivia (£1)	14/3	13/6	13/9	July, 1927	5 p.c.
Mexican Corpn. (£1)	11/1½	10/4½	11/—		
Mexico Mines of El Oro (£1)	18/9	16/3	17/6	Dec., 1926	3½ p.c.*
N'Changa C pper Mining	13/—	12/6	12/6		
Oroville Dredging (£1)	5/6	5/—	5/6	Dec., 1923	3½ p.c.
Ouro Preto (£1)	3/1½	2/3	2/6	May, 1925	2½ p.c.
Rhodesian Congo Border (£1)	60/—	54/4½	58/9		
St. John del Rey (£1)	11/9	11/3	11/9	May, 1927	3½ p.c.
San Francisco Mines (10s)	30/3	29/6	29/9	July, 1927	15s.
Santa Gertrudis (£1)	19/4½	17/—	19/—	July, 1927	7½ p.c.
Selukwe (2s. 6d.)	8/9	8/3	8/6	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	3/1½	2/10½	3/—	Nov., 1917	75 p.c.
Tanganyika (£1)	58/1½	48/6	50/7½	Aug., 1926	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	9.360	9.200	9.200	July, 1927	182.60 (‡)

* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation.

New Machinery and Inventions



Two 155-hp. motors drive this high-powered locomotive

Air-Operated Contactors Are Used on This Locomotive

The Westinghouse Electric & Manufacturing Co. has produced what is claimed to be the most powerful mine locomotive ever built. The first of its type, this machine is said to incorporate the latest refinements of design dictated by results of past operating experience.

On an average grade of 1 per cent against the loaded trip, it is stated that this locomotive will haul 50 loaded cars, each having a capacity of 2½ tons, at a speed of 9 miles an hour. The usual trip at the plant for which the locomotive was built will consist of 40 loaded cars hauled at a speed of 10½ miles per hour, up an average grade of 0.9 per cent for a distance of 10,000 ft.

Some of the features of the design of this locomotive are: Barsteel frame, electro-pneumatic control for series-parallel operation, air sanders, and relay overload protection.

Oil-Electric Locomotives Show Big Savings

Railroad records on the comparative performance of steam and oil-electric locomotives, such as are used at large mining plants and railroad systems, surveyed for the first time by the Ingersoll-Rand Co., show to the advantage of the oil-electric type a possible saving of $337,000,000 a year. Oil-electric operating cost for fuel, oil, water, and other engine supplies was found to be only one-fourth that of steam. The survey, recently made public, covers all oil-electric locomotives now in service on twelve Class I railroads. It includes locomotives of both the 60- and the 100-ton type, and covers 173,465 miles of active service. The average operating cost of the oil-electric locomotives for fuel and lubricating oil, grease, water, and other engine supplies was 4.8c. a locomotive mile. This compares with an average cost for the same items for steam locomotives engaged in yard service on all Class I railroads of 22.8c.

The average cost of operation of 60-ton oil-electric locomotives, covering 135,983 miles, was 4.4c. a locomotive mile. For a 100-ton oil-electric, the cost for fuel, oil, water, and other engine supplies was 6.8c.

Fuel cost is the biggest single item, other than wages and repairs, in the operating cost of both steam and oil-electric locomotives, and in this item the survey shows the biggest saving in oil-electric over steam operation.

The average cost for fuel oil for the 60-ton oil-electric locomotive, with fuel oil figured on a cost basis of 5c. a gallon, is 2.9c. a locomotive mile. For the 100-ton oil-electric, the fuel cost is 4.8c. This compares with an average fuel cost for all steam locomotives engaged in yard service on Class I railroads, on the basis of returns to the Interstate Commerce Commission for 1925, of 20.6c. a locomotive mile.

For lubricating oil and grease the operating cost of the oil-electric locomotive is higher than for the steam locomotive. The 60-ton oil-electric costs on an average 1.5c. a mile for lubricating oil and grease, as compared with an average cost of one-half cent a mile for steam locomotives.

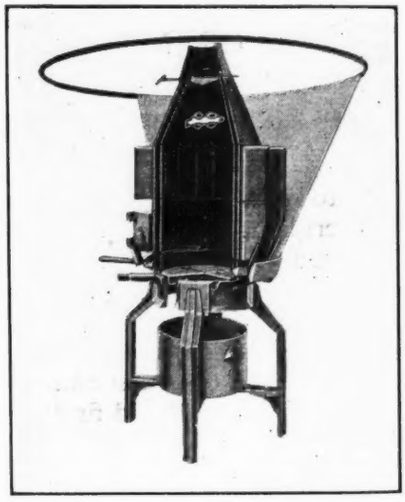
In water costs there is a very distinct saving in favor of the oil-electric. Four railroads, users of oil-electric locomotives, reported the water cost as negligible, and five other railroads reported a water cost of .000024c. per mile. The cost for water alone, not taking into consideration the necessary accessories such as tanks, troughs, and reservoirs, for steam locomotives averages about 1.3c. a locomotive mile.

Class I railroads spent $73,977,000 in 1925 for fuel, oil, water, and other engine supplies for steam locomotives engaged in yard service. Oil-electric operation, on the basis of the figures now made available for the first time as a result of the survey, would make for an annual saving to the railroads, in yard service alone, of $55,000,000. If the same ratio of saving was applied to all steam locomotives now in use, oil-electric operation would effect an annual saving to the railroads, in yard service alone, of $55,000,000. If the same ratio of saving was applied to all steam locomotives now in use, oil-electric operation would effect an annual saving of $337,000,000 in the items of fuel, oil, and water, alone.

The survey also disclosed an availability record of 85 per cent for the oil-electric locomotive. This compares with an average availability of 40 per cent for the steam locomotive. Five railroads reported the number of days oil-electric locomotives had been in service. Over a period of 1,011 days six oil-electric locomotives were operated on an average of 20.5 hours a day. Figured on this basis, the oil-electric locomotive is capable of giving twice as many hours of locomotive service as a comparable steam locomotive, and can do the work of two steam locomotives. This is being demonstrated on one of the railroads where two oil-electric locomotives are now doing the work that formerly required the services of four steam locomotives.

Sand Drier with Large Heating Surface

Edward C. Kirk & Sons, of Charleston, W. Va., present a sand drier of entirely new design. Cast integral with the outside walls of the fire pot are a number of heavy fins which add



Drier built on definite principles

many square feet to the sand-heating surface. Through the walls of the fire pot and dome are sixteen vertical air channels with outlets to the stack, but arranged so that they are not closed by the stack damper. Eight of these channels get their air supply through the grate, which is hollow, and the other eight have numerous openings in contact with the sand. The idea of the design is to prevent burning of the grate and fire pot and to provide easy means for escape of moisture from the warm sand. At the bottom of the hopper is a movable ring, having pins which project a few inches up into the hopper. Moving the ring back and forth through a slight angle, by means of a lever, stirs the sand in the bottom and opens any of the clogged holes.